VOL. XXI. [DECEMBER, 1899.] NO. 12.

THE JOURNAL

OF THE

AMERICAN CHEMICAL SOCIETY.

THE NATURE OF THE CHANGE FROM VIOLET TO GREEN IN SOLUTIONS OF CHROMIUM SALTS.[1]

BY W. R. WHITNEY.

Received October 10, 1899.

AN article entitled "The Nature of the Change from Violet to Green in Solutions of Chromium Salts," was published by Venable and Miller in this volume of the Journal, pages 484–496.

As it does not seem that the conclusions drawn in that article are supported by the experimental evidence presented by them, and as I believe that the statements there made are misleading because of the imperfect presentation and discussion of facts previously known, I desire to call attention again to the subject.

The question under discussion concerns the change in composition taking place when a solution of a violet chromium salt, such as chromic sulphate, is heated, the solution then changing in color to green. The following are some of the facts which have been discovered and published by various investigators as evidence for the belief that the green solution, unlike the violet solution, contains a considerable quantity of free sulphuric acid, a conclusion disputed by Venable and Miller.

1. The green solution is strongly acid to all indicators and is

[1] Read before the Columbus meeting of the American Chemical Society, August 21, 1899.

partially precipitated by barium chloride, giving barium sulphate. These facts together are evidence of the presence of some free sulphuric acid.

2. Distillation of the green solution results in an acid distillate, while the dried salt may be heated above 100° C. without loss of acid.[1]

3. Dialysis of the green solution gives a product in the diffusate containing proportionately more SO_4 than was obtained by diffusion of the violet solution.[2]

4. Sulphuric acid has a retarding action on the change from violet to green taking place when the solution is heated. If sulphuric acid is present in the green solution as one of the products arising from the conversion of the violet salt, its addition should retard the conversion in accordance with the law of mass action.

5. Conversely, alkalies accelerate the change from violet to green (Van Cleeff). On the assumption that free acid is present this also would be acquired by the law of mass action.

6. Alcohol poured in a layer over the green solution takes up acid from that solution.[3]

7. The heat generated on the addition of various quantities of sodium hydroxide to a quantity of the green solution has been carefully measured and the following results obtained: The addition of sodium hydroxide caused at first a generation of heat for each additional portion, exactly equal to that generated when the sodium hydroxide was added to sulphuric acid alone. This relation ceased when a quantity of alkali had been added equal to one molecule of sodium hydroxide to one of chromic sulphate. When more than one molecule (but not when less than one) has been added, the subsequent addition of sulphuric acid brings about a generation of heat. If the first molecule of sodium hydroxide had caused the formation of a chromium hydroxide instead of sodium sulphate in the solution, the addition of acid would have produced a generation of heat. This indicates that there is one molecule of free sulphuric acid for each two molecules of the original chromic sulphate present.[4]

[1] Recoura: *Compt. rend.*, 112, 1440.
[2] Van Cleeff: *J. prakt. Chem.*, 23, 58; Dougal: *J. Chem. Soc.*, 69, 1527.
[3] Krüger: *Ann. phys. Chem.*, (3), 61, 218.
[4] Recoura: *Ann. chim. phys.* (7), 4, 494.

8. The electrical conductivity of the violet solution is much less than that of an equally concentrated green solution, the difference being readily explained by the presence of free acid in the green solution, inasmuch as free acids are known to be much better conductors than their neutral salts.[1]

9. The electrical conductivity of the green solution is decreased at first by the addition of alkali. This reduction of conductivity ceases as soon as one molecule of sodium hydroxide has been added to each molecule of chromic sulphate of the original solution, while still further addition of the hydroxide causes an increase in the conductivity.[1] This can hardly be explained otherwise than by the assumption that free acid is present and that it is neutralized by the alkali. If no chemical change occurred when sodium hydroxide was added to the green solution the electrical conductivity would, of course, increase. It is hard to see how it could diminish to any considerable extent except in case free acid is present. The hydrogen ions of this acid and the OH ions of the base forming as they do undissociated water molecules and thus ceasing to take part in the electrical conductivity, would, however, account for the considerable reduction in conductivity observed. The above is a fact corresponding perfectly with the discovery of Recoura from his thermochemical measurements, that one free sulphuric acid molecule is present in the green solution of two molecules of chromic sulphate. Sodium hydroxide added to the violet sulphate solution does not produce the above effect except to a very slight extent; the conductivity of the solution increases after a very small addition of the hydroxide.

10. Finally, the green solution inverts cane-sugar solutions and hydrolyzes methyl acetate, and to the same extent as a solution of sulphuric acid containing an amount of acid corresponding to one molecule for two of original chromic sulphate. All investigations previously made have led to the conclusion that this inverting or catalyzing action does not occur with neutral salts and in acid solutions is approximately proportional to the concentration of the hydrogen ions present.[2] Violet solutions of chromic sulphate do not possess this hydrolyzing power.[1]

[1] Whitney: *Ztschr. phys. Chem.*, 20, 40.

[2] See J. H. Long: This Journal.

These facts Venable and Miller treat in the following manner: "We think the experimental data of these authors do not afford sufficient and satisfactory evidence to serve as a basis for their conclusions that free sulphuric acid exists in the solution. The methods adopted are very indirect and the results capable of other explanation." Unfortunately, however, no other explanations are suggested by the authors, nor is the reasoning of other investigators in this field refuted to the slightest degree by them.

The entire experimental work of the authors bearing on this matter, which they apparently consider to outweigh the above evidence showing the presence of free acid, consists of a single experiment, which is as follows: Decinormal ammonia was added to a violet and to an equivalent green chromic sulphate solution until the first appearance of a permanent precipitate was noted, and it was found that the two required, within about four per cent., the same volume of the ammonia solution. They seem to conclude, therefore, that the two contain the same amount of acid, and apparently have overlooked the significance of the fact stated on a preceding page of their article and previously announced by Van Cleeff, "Sodium, potassium, or ammonium hydroxide or the carbonate readily turned the violet solution green." This change in color, moreover, precedes the formation of the permanent precipitate. It seems superfluous to add that if the ammonia changes the violet to a green solution it is an unsuitable reagent to use in attempting thus to distinguish the acidity of the solutions.

NEW EXPERIMENT ON THE FREE ACID.

I have performed the following experiment, which again proves the presence of the stated amount of free acid in the green solution.

In order to separate the free acid from the green solution of the chromium compound, in which it cannot be titrated with alkali owing to the progressive decomposition of the chromium compound, the plan was adopted of passing an electric current through the solution and thus causing a removal of the acid from the chromium into an adjoining solution of a simple salt, owing to the more rapid migration of the hydrogen ions.

In order to avoid stirring and convection currents in the solution, the artifice of gelatinizing the solution as employed by Arrhenius,[1] Oliver Lodge,[2] and Whetham[3] was made use of.

It having been found by Arrhenius that the effect on the velocity of migration of different salts by the solidification of the solution with gelatine was not great, and was practically constant for different substances in the same jelly, Whetham employed the method in obtaining the specific velocities of migration of various ions, finding, for example, that the hydrogen ion moved about five times as fast as the chlorine and three times as fast as the next in order to itself, the hydroxyl ion.

It was on this difference in velocity of migration that it was hoped a method of separation could be based.

The experiment was first carried out as follows: An aqueous solution of 0.5153 gram of $Cr_2(SO_4)_3 14.8H_2O$ was boiled thirty minutes to change the salt completely into the green modification. This was made into a jelly by use of two per cent. of agar-agar. A large quantity of two per cent. agar-agar jelly was also prepared containing a few per cent. of potassium sulphate and some methyl orange as indicator. A straight glass tube about forty cm. long and having an internal diameter of about two cm. was corked at one end, placed perpendicularly, and filled nearly half full of the neutral potassium sulphate agar-agar solution, which was then allowed to solidify. The melted agar-agar solution containing the green chromium compound was then poured into the tube and allowed to solidify on top of the first jelly. When this was in turn solid, the tube was filled to the end with more of the potassium sulphate jelly. There was thus obtained a solidified solution of the green compound about three cm. long between similar solutions of neutral salt. The cork having been removed, the ends of the tubes were fitted with glass elbows and the whole arranged horizontally with the elbows turned upwards. In one of these elbows was placed an aqueous solution of zinc sulphate and a zinc electrode, in the other copper sulphate solution and a copper electrode. Thus there could be no acid or alkali produced at the electrodes. The whole apparatus was surrounded by cold water to prevent the liquefaction of the agar-agar due to the

[1] Kongl. Vetenskaps.—Akademiens Fördhandlingas, (1885).
[2] B. A. Report, 395 (1886).
[3] *Phil. Mag.*, 392 (1894).

heat of the electric current. The current from a 110-volt circuit was passed through a thirty-two candle-power lamp and this apparatus in series, the copper pole being made the cathode. The current resulting was probably not far from three-quarters of an ampere. The jelly adjoining the green zone towards the cathode immediately began to redden and the resulting red zone augmented slowly towards the cathode, as the methyl orange was effected by the advancing acid. After four and a half hours, when the methyl orange had been reddened for a distance of 16.5cm. the current was interrupted and the jelly pressed out of the tube. The reddened portion was cut out and divided into two parts. One constituting the end towards the cathode had a length of 14 cm. and the other adjoining the chromium compound a length of 2.50cm. These portions were extracted with cold water until the jelly contained no more acid and the resulting extracts titrated. The larger portion required 12.95 cc. of sodium hydroxide (0.0504 normal) solution, the smaller 0.63 cc. of the same solution, showing that the migrating acid was principally in the forward part of the moving reddened zone. The total quantity of sulphuric acid thus found was 0.0355 gram, while a calculation on the basis of Recoura's hypothesis, *i. e.*, one molecule of free acid for two of original chromic sulphate, requires 0.0379 gram. In other words, 88.4 per cent. of the acid hypothetically present had been obtained. Owing to the long period necessary for this migration it was certain that the green compound reverted somewhat to the violet, thus reducing the quantity of free acid, and in fact the movement of a narrow violet zone due to the chromium ions was plainly visible between the green and reddened portions of the jelly, the green color having moved no more than to the small extent attributable to ordinary diffusion.

The above experiment was repeated with chrome alum under improved conditions. This time the jelly was removed after being in use between two and three hours. It was separated into its differently colored parts, and that containing chromium was this time reheated to reconvert any violet chromium sulphate into the green modification. It was then returned to the tube as before, together with fresh portions of the neutral potassium sulphate jelly. On the passage of the current a faint red zone was produced, but not nearly so marked as before, and

it was soon evident that the acid had all been separated from the chromium compound. The total quantity of acid obtained on extraction of the reddened portions of jelly was titrated as before.

In this case 0.8125 gram of chrome alum had been used, corresponding theoretically to 0.0399 gram of free sulphuric acid. There were 16.3 cc. of the alkali solution used to neutralize the free acid, which corresponds to 0.0402 gram of sulphuric acid instead of 0.0399. This is as close an agreement as the process could be expected to give. Experiment showed that no measurable action of free acid on the agar-agar takes place under the conditions of the above process.

It was now desirable to perform a similar experiment with the violet solution. On making the jelly containing the alum as before, it was found that the return of the violet color which was changed to green by the melting of the agar-agar solution, required at least weeks for its completion, and therefore for this purpose the solution of the alum in the hot melted agar-agar had to be abandoned. It was found, however, that on placing the solid powdered alum between two pieces cut from a jelly cast in the tube above described, the substance dissolved quite readily, and rapidly diffused throughout the pieces of jelly. Such a plug of the jelly, containing two-tenths gram of alum, was placed in the center of the tube with the neutral potassium sulphate jelly as before and the current passed through the whole for an hour. It failed to yield sufficient acid to affect the indicator, though the relatively slow migration of the chromium ions was evident. These experiments therefore show the presence of the free acid in the green sulphate solutions and determine that its amount corresponds to the hypothesis of Recoura.

THE NON-PRECIPITABLE SULPHATE.

Favre and Valson[1] fractionally precipitated the green chrome alum solution by adding to it successively portions of barium chloride solution equivalent to one-quarter of the quantity theoretically necessary to precipitate all the SO_4 present. The first and second quarters were immediately and completely used up in precipitating barium sulphate, while the third quarter produced a very slowly appearing cloudiness, which became an

[1] *Compt. rend.*, 74, 1032.

actual precipitate only after the expiration of a considerable time. The heat generated in this reaction was likewise measured. For the first, second, and third quarters of barium chloride added, 4104, 4102, and 146 calories, respectively, were generated. Thus, these authors were led to conclude that only half of the sulphuric acid actually present is immediately precipitable.

Recoura[1] simply states that he has confirmed this conclusion, and advances the following reaction and formulas as representing the compounds actually in the green solution:

$$2K_2SO_4Cr_2(SO_4)_3 + H_2O = 2K_2SO_4 + Cr_4O[SO_4]_4SO_4 + H_2SO_4.$$

In this case, the SO_4 in the brackets assumed to be a part of a positive radical attached to a single SO_4, and forming one-half of the total SO_4 present would be the non-precipitable portion. Venable and Miller also attempted to investigate the point quantitatively. As they were unable to filter the precipitated sulphate, because of its finely divided condition, until after the lapse of about twenty-four hours, it is not surprising that they obtained in the precipitates about ninety per cent. of the total SO_4 present. To obtain a satisfactory separation of the immediately precipitable sulphate, it is necessary that the barium sulphate at first thrown down should be filtered at once, for the remainder of the SO_4 present will be slowly precipitated, as described by Favre and Valson, owing to the gradual return of the green to the violet compound.

The following quantitative evidence on this point has been obtained:

Two solutions were made by dissolving 0.5982 and 0.4605 gram of recrystallized chrome alum, each in about 100 cc. of water at 0° C. An excess of a four per cent. barium chloride solution, also at 0° C., was slowly added to each from a burette, the solutions being constantly stirred. The precipitates of barium sulphate were filtered and washed immediately. They were perfectly white and on ignition weighed 0.5508 and 0.4249 gram, respectively. This corresponds in each case to 98.7 per cent. of the SO_4 theoretically present in the alum. The filtrates

[1] *Ann. chim. phys.* (7), 4, 502.

yielded no further precipitates on being boiled. This shows that the SO_4 can be precipitated immediately from the ordinary violet solution of chrome alum at 0° C.

The green solutions to be precipitated were made by dissolving known weights of the alum in water and boiling for half an hour. After being cooled to 0° C. these were precipitated as above, more of the precipitant being added in each case than would be necessary to throw down all the sulphuric acid present in whatever form. The resulting precipitates collected on double filter-papers were of different shades of green and evidently contained varying quantities of the chromium compound. After thoroughly washing these precipitates they were digested with boiling dilute hydrochloric acid, the acid evaporated almost to dryness, and the precipitates, after being digested with boiling water, were filtered. These were then fused with sodium carbonate and the sulphate in the filtered and acidified solution of the fusion, reprecipitated. The following table contains the results:

Alum.	Total $BaSO_4$ calculated.	$BaSO_4$ found.			Precipitated SO_4.
		a.	*b.*	*c.*	Per cent.
0.8064	0.7531	0.4336	....	0.4129	54.9
0.7255	0.6776	0.3787	....	0.3397	50.1
0.5062	0.4728	0.2557	....	0.2515	53.2
0.6470	0.6042	0.3490	....	0.3409	56.4
0.8235	0.7690	....	0.4102	0.4042	52.5
0.9160	0.8554	....	0.4564	0.4489	52.4

The values under *a* give the weights of the greenish precipitates at first obtained, so far as they were determined. All of these precipitates yielded considerable quantities of chromium and of sulphuric acid to the hydrochloric acid used in their purification. Under *b* are the weights of the precipitates after the hydrochloric acid treatment, and under *c* the weights of barium sulphate after fusion with the sodium carbonate and reprecipitation. These latter were used in the calculation of the percentages of precipitable sulphuric acid which appear in the last column.

When the difficulties connected with this determination are taken into account, it is probable that exactly one-half of the sulphuric acid of a green solution of chrome alum is present in a form which does not readily yield the SO_4 ion. The fact

that the filtrates from the above precipitates remained perfectly clear for periods of from thirty to ninety minutes, varying with the temperature at which they were kept, is worthy of note.

It is therefore clear that all experimental evidence thus far points to the correctness of Recoura's peculiar symbols representing chromium compounds, for here in the case of the chrome alum solution, the free acid, as well as the directly ionizable sulphuric acid radicals, has been shown to correspond in quantity with the requirements of the symbol,

$$2K_2SO_4 \; ; \; Cr_4O(SO_4)_4SO_4 \; ; \; H_2SO_4;$$

i. e., one-half of the SO_4 exists as ordinary sulphate, including one-eighth as free acid, and the other half in a condition of considerable stability and non-precipitable, at ordinary temperatures.

LABORATORY OF THE MASSACHUSETTS
INSTITUTE OF TECHNOLOGY.

THE DETERMINATION OF THE BROMINE ABSORPTION OF OILS.

BY PARKER C. MCILHINEY.

Received September 22, 1899.

SOME time ago the writer suggested a method of fat analysis, having the same end in view as the Hübl process; *viz.*, the determination of the unsaturated constituents of fats and oils.[1] Since then Hehner[2] has called attention to the fact that Allen[3] had previously described a similar method of analysis for shale oils. This fact had escaped the writer's attention and his apologies are due to Mr. Allen for the omission of credit where it belonged.

Further experience with the method has confirmed the belief that its results are more valuable than those given by the Hübl process, and recently it has been found possible to so modify its details that it can be carried out more easily and expeditiously. The method consists briefly in adding to a weighed portion of the fat or resin in a stoppered bottle, an excess of standard solution of bromine in carbon tetrachloride, and, after the reaction between them has taken place, determining the excess of bromine

[1] This Journal, 16, 275.
[2] *Analyst*, 20, 40 (1895).
[3] Commercial Organic Analysis, second edition, 2, 383.

by adding an aqueous solution of potassium iodide and titrating with sodium thiosulphate. Any hydrobromic acid which may have been formed in the reaction is determined in the aqueous solution. The percentage of bromine found as hydrobromic acid is called the bromine substitution figure, and the total percentage of bromine absorbed, less twice the bromine substitution figure, gives the bromine addition figure.

When the original article was written the rapidity with which bromine reacts with fats was not appreciated. On investigation it was proved that if the fat is treated with double the quantity of bromine with which it can combine, the reaction between them is complete within one minute; no higher addition figures were obtained when the tests were continued for a number of hours. This agrees with the statement of Hehner and Mitchell that the reaction is instantaneous. The process can therefore be carried out very rapidly.

Several objections to the Hübl process may be stated as follows:

1. The solution of iodine and mercuric chloride is not a stable one. When freshly prepared, its action is apt to be erratic for the first few hours and after that its strength steadily decreases. The result of this is that several hours must be devoted to the preparation of the reagent before the analysis proper can be carried on.

2. The reaction between the reagent and oil is not instantaneous; in fact several hours are required for its completion. With drying oils probably eighteen hours are required. This further delays the analysis.

3. The process does not distinguish between iodine absorbed by addition and that absorbed by substitution. In the case of pure glycerides this is not so serious a defect as in the case of hydrocarbon oils and resins, which absorb halogen mostly by substitution of the halogen for hydrogen. The time allowed for the reaction affects the amount of halogen absorbed to a much greater extent with the latter class of substances than with glycerides, so that no definite Hübl figures can be given for them except as a time is arbitrarily fixed for the reaction. This defect of the method is very marked in the case of rosin. Another result of the lack of distinction between addition and

substitution in the Hübl process is that substances whose behavior toward halogen is essentially different, such as rosin and linseed oil, may give the same Hübl figures.

The superiority of bromine over iodine as a reagent in fat analysis has been shown by many investigations during the last three years. A process devised by Hehner and Mitchell,[1] in which the heat developed by the reaction between bromine and oils is measured, appears to possess very decided merits on the score of rapidity, especially if a large number of samples are to be examined at one time. This advantage is not apparent, however, if only a few samples are to be examined. It is open to one of the same objections as the Hübl process in failing to distinguish between addition and substitution and further the errors of the thermometer reading are multiplied by five and a half in calculating the Hübl figure. It would seem to the writer, although he has had no personal experience with it, that its advantages in rapidity are also possessed by the method which forms the subject of this paper.

The method formerly employed for determining the bromine substitution figure, was to determine the acidity to methyl orange of the aqueous liquid separated from the carbon tetrachloride after the titration with thiosulphate. Experiments were made to compare the results obtained by using methyl orange and by lacmoid and by determining the acid iodometrically with potassium iodate and iodide. The results of the tests showed that in the case of many oils there was little or no difference between the figures obtained. In the case of others, however, the end-reaction with methyl orange was indistinct, and lacmoid gave high figures. This is undoubtedly due to the presence of fatty acids in the solution. The iodometric determination in the same way as used by Schweitzer and Lungwitz,[2] is therefore to be recommended, especially as it involves no separation of the aqueous portion from the carbon tetrachloride and the same thiosulphate solution serves for determining both the excess of bromine and hydrobromic acid.

The process as at present used is as follows: A quantity of the oil to be analyzed is weighed into a glass-stoppered bottle,

[1] *Analyst*, 20, 49, 146 (1895); *J. Soc. Chem. Ind.*, 16, 87, 309 (1897); This Journal, 18, 378 (1896).

[2] *J. Soc. Chem. Ind.*, 14, 130 (1895).

ten cc. of carbon tetrachloride added to dissolve the oil, and twenty cc. of third-normal bromine in carbon tetrachloride added from a pipette. It is not found necessary in filling the pipette with bromine solution to use any special arrangement to prevent the introduction of bromine vapor into the mouth. Only a rubber tube is necessary. Another pipette full of solution should be added to ten cc. of carbon tetrachloride, and this blank titrated with thiosulphate to determine the strength of the bromine solution. The test itself need be allowed to stand only one or two minutes before adding twenty to thirty cc. of ten per cent. solution of potassium iodide, the amount necessary depending upon the excess of bromine present. An excess, of course, does no harm. In order to prevent any loss of bromine or hydrobromic acid which would probably occur on removing the stopper of the bottle, a short piece of wide rubber tubing, of the sort used for Gooch crucibles, is slipped over the lip of the bottle so as to form a well around the stopper. It is advisable, also, to cool the bottle by setting it into cracked ice in order to produce a partial vacuum in the interior. Into the well formed by the rubber tubing is poured the solution of potassium iodide and the stopper opened slightly. If the bottle has been cooled with ice the iodide solution will be sucked into the bottle, and if it was not cooled some of the air from the interior of the bottle will bubble through the iodide solution, being thereby washed, and allow the iodide solution to enter the bottle. When sufficient iodide solution has been introduced the bottle is agitated to insure the absorption of the bromine and hydrobromic acid by the aqueous solution. The iodine now present is titrated with tenth-normal sodium thiosulphate and when the titration is finished five cc. of a neutral two per cent. solution of potassium iodate is added. This liberates a quantity of iodine equivalent to the hydrobromic acid formed and on titrating this iodine the bromine substitution figure may be calculated. The solution of potassium iodate should be tested for acidity by adding a measured quantity to a solution of potassium iodide and if any iodine is liberated it should be determined with thiosulphate and a suitable correction introduced into the calculation. The potassium iodide, the thiosulphate solution, and the water used should all be tested to see that they are neutral.

The reaction between bromine and oil appears to be practically instantaneous as far as the bromine taken up by addition is concerned but it seems likely that substitution is distinctly affected by the length of time that the oil and bromine are allowed to remain in contact. The extent to which time affects the substitution figure has not yet been accurately determined, but it is not likely that in ordinary work any serious error is introduced in this way. Experiments to determine accurately the effect of time upon the substitution figure have been undertaken and will be reported later.

For the process in its present form the following advantages may be claimed:

1. The standard solution of bromine is not subject to change on keeping; therefore it may be kept on hand ready for use at short notice; further, it is very easily prepared.

2. The process requires only such time as is necessary for the weighing and the titration, no time being lost in preparing standard solutions or waiting for completion of the reaction between bromine and oil.

3. The absorption of halogen by addition is determined separately from the absorption by substitution, and thus additional information is gained as to the nature of the substance.

4. The solvent used (carbon tetrachloride) is easily recovered, and bromine is cheap, so that the whole process is much cheaper than the Hübl.

The following figures have been obtained upon samples of various oils which are believed to be representative of their respective classes.

The figures given in the last column, obtained by dividing the calculated bromine figures by the actual bromine addition figures, are intended to represent by the amount that they exceed 1,000, the extent to which substitution goes on in the determination of the Hübl figure. Thus 1.103 represents that over and above the iodine absorbed by addition; 10.3 per cent. of this amount was absorbed by substitution.

	Hübl figure.	Bromine calculated from Hübl.	Per cent. of bromine absorbed.	Bromine addition figure.	Bromine substitution figure.	Bromine from Hübl divided by bromine addition figure.
Raw linseed oil, several years old, 1	166.9	105.2	98.4	95.4	1.5	1.103
Raw linseed oil, several years old, 2	157.3	99.1	99.2	92.0	3.6	1.000
Raw linseed oil, 3	184.2	116.1	116.1	109.6	3.4	1.059
" " " 4	178.6	112.6	108.5	102.1	3.2	1.102
" " " 5	185.9	117.2	113.2	109.2	2.0	1.072
" " " 6	186.3	117.0	112.2	106.5	2.9	1.098
" " " 7	....	....	104.5	99.9	2.3	....
" " " 8	....	....	115.1	109.5	2.8	....
" " " 9	....	....	114.6	109.4	2.6	....
Av. omitting Nos. 1 and 2	183.8	115.7	112.0	106.6	2.7	1.083
Boiled linseed oil, 1	180.4	113.7	106.0	100.8	2.6	1.126
" " " 2	183.3	115.5	110.8	105.8	2.5	1.091
" " " 3	....	....	105.4	101.2	2.1	....
" " " 4	....	....	110.0	103.2	3.4	....
" " " 5	....	....	109.8	105.2	2.3	....
" " " 6	....	....	113.6	103.0	5.3	....
" " " 7	....	....	109.2	103.8	2.7	....
" " " 8	....	....	110.8	101.0	4.9	....
Averages	....	....	109.5	103.0	3.2	....
Petroleum neutral oil, sp. gr. 0.8436	....	....	14.4	6.4	4.0	....
Third run rosin oil, 1	....	....	197.6	16.4	90.6	....
" " " " 2	63.9	40.3	92.3	7.7	42.3	5.231
"Mystic" brand rosin oil	....	....	93.7	6.3	43.7	....
"Java" boiled rosin oil	73.3	46.2	101.9	8.3	46.8	5.685
Menhaden oil, 1	178.8	112.7	114.5	96.5	9.0	1.169
" " 2	170.4	107.4	107.3	92.3	7.5	1.164
" " 3	175.4	110.6	110.1	97.9	6.1	1.129
Averages	174.9	110.2	110.6	95.6	7.5	1.154
Corn oil, 1	....	....	76.2	73.8	1.2	....
" " 2	....	....	75.8	73.2	1.3	....
" " 3	....	....	75.4	71.6	1.9	....
Averages	....	....	75.8	72.9	1.5	....
Cottonseed oil	....	....	65.8	62.2	1.8	....
Turpentine	....	....	266.1	166.1	50.0	....
Benzine, turps. substitute, 1, sp. gr. 0.741	....	....	51.5	15.5	18.0	....
Benzine, turps. substitute, 2, sp. gr. 0.733	....	....	6.3	2.7	1.8	....
Window glass rosin	....	....	161.4	8.0	76.7	....
Black rosin	....	....	135.4	5.4	65.0	....
Ceylon cocoanut oil	....	....	5.36	4.7	0.33	....
Tallow ren'd in lab'rat'y	....	....	24.0	21.48	1.26	....
Hard paraffin	....	....	3.55	1.43	1.06	....

THE DIRECT DETERMINATION OF AVAILABLE PHOSPHORIC ACID.

By F. P. Veitch.

Received September 4, 1899.

THE direct determination of available phosphoric acid is not new, being official in several of the European countries. In this country, however, it has not met with favor, probably because the citrate method is not official here. The necessity of destroying the organic matter before precipitating with molybdate solution precludes the use of the molybdate method.

In 1893 Ross presented a method[1] for the direct determination of the reverted phosphoric acid. While the aim of this method met with hearty approval from the official chemists, the method itself did not, owing to some difficulties met with in the manipulation, and more particularly to the fact that it did not give results agreeing with the official method.[2] Agreement could hardly be expected seeing that the method did not account for that phosphoric acid removed in the water used in washing the citrate insoluble. Believing that this last-mentioned fact, *viz.*, that the Ross method did not account for the phosphoric acid contained in the wash-water of the official method, is the principal cause of the difference in the results by the two methods, in 1895, the writer did some work with the view of proving his hypothesis. This work consisted of the determination of the water-soluble phosphoric acid by the volumetric method, as modified and carried out by the writer ;[3] the direct determination of the citrate-soluble by the citrate method, in fifty cc. of the citrate filtrate, and the determination of that removed by washing the citrate-insoluble residue, using the modified volumetric method. The sum of these three results should equal the available phosphoric acid by the official method.

It is perhaps sufficient to say that the citrate method at that time and later[4] gave satisfactory results on sixty or seventy samples. The results of the comparison are given in the table.

1 U. S. Department of Agriculture, Division of Chemistry, Bulletin 38, p. 17.

2 U. S. Department of Agriculture, Division of Chemistry, Bulletin 43, p. 72 ; and Bulletin 47, p. 81.

3 This Journal, **18**, 389, and U. S. Department of Agriculture, Division of Chemistry, Bulletin 49, p. 61.

4 U. S. Department of Agriculture, Division of Chemistry, Bulletin 49, pp. 61, et seq.

	Direct method.					Official method.	
	Soluble. Per cent.	Reverted. Per cent.	Wash. Per cent.	Available. Per cent.	Total. Per cent.	Available. Per cent.	Total. Per cent.
1	10.13	3.60	0.24	13.97	16.15	14.00	16.18
2	12.46	2.96	0.17	15.59	16.09	15.49	15.99
3	10.88	3.68	0.21	14.77	16.10	14.79	16.12
4	4.80	5.13	0.29	10.22	11.70	10.14	11.62
5	8.25	2.65	0.47	11.37	12.17	11.24	11.97
6	7.56	3.61	0.26	11.45	14.48	11.58	14.64
7	8.08	2.24	0.25	10.57	12.79	10.64	12.75
8	7.00	4.76	0.37	12.08	16.48	12.21	16.54
9	9.03	3.12	0.28	12.43	13.86	12.31	13.74
10	1.18	6.22	0.68	8.08	12.74	8.03	12.69
11	1.08	6.35	0.99	8.42	12.96	8.32	12.86
12	3.10	4.88	1.48	9.46	15.41	9.50	15.45
13	5.10	1.73	0.21	7.04	8.16	7.03	8.35
14	8.87	2.10	0.09	11.06	11.39	10.86	11.19
15	4.75	2.30	0.39	7.44	8.84	7.45	8.85
16	4.97	2.98	0.38	8.33	10.72	8.44	10.83
17	4.27	2.34	0.19	11.80	12.53	11.82	12.55
18	7.47	3.34	0.30	11.11	13.28	11.23	13.40
19	5.55	3.59	0.40	9.54	14.48	9.70	14.64
20	7.50	2.06	0.16	9.72	11.92	9.70	11.90

Nos. 1, 2, and 3 were dissolved S. C. rock.

Nos. 4, 5, and 6 were dissolved S. C. rock and potash.

Nos. 7, 8, and 9 were dissolved animal bone.

Nos. 10, 11, and 12 were raw bone.

Nos. 13, 14, 15, 16, 17, 18, 19 and 20 were compounded for this work and were complete fertilizers.

The two methods gave practically the same results on availables and on totals. The work also shows very plainly why the Ross method differs from the official, from 0.09 per cent. to 1.48 per cent. being removed and accounted for in the wash-water of the official method that could not be accounted for by the Ross method. Of course the amount removed by the wash-water will vary somewhat in the hands of different analysts, according as they wash the citrate-insoluble much or little. It is the practice of the writer to wash until the filtrate and washings amount to about 250 cc.

At this point pressure of other work necessitated the dropping of this, and nothing more was done until the present summer, when it was determined to extend the work somewhat.

A comparison of the official method with the citrate and the molybdate methods, precipitating with magnesia mixture and

with molybdate solution, respectively, in the mixed filtrates, containing the water-soluble and the citrate-soluble, was undertaken.

The method pursued was as follows: the water-soluble, extracted as usual, was received in a 500 cc. flask, graduated roughly at 250 cc. and containing five to ten cc. nitric acid. The citrate-soluble was then extracted as usual, the filtrate and washings received in the flasks with the water-soluble. After cooling, the volume was completed, shaken, filtered, and in aliquots of 100 cc. the phosphoric acid was determined by each method, the molybdate solution being added directly to the solution without destroying the organic matter, but the precipitates were allowed to stand over night before filtering. The determinations were completed as usual. The samples were carefully selected to represent most classes of goods found on our markets. Most of them contained organic matter, some in considerable quantities.

		Available official method. Per cent.	Available direct. Molybdate method. Per cent.	Available direct. Citrate method. Per cent.
21	Dissolved S. C. rock	15.87	15.84	15.40
22	" " " "	14.40	14.51	14.50
23	" " " " and potash	13.45	13.45	13.24
24	" " " "	14.82	15.04	14.53
25	" " " "	15.60	15.66	15.47
26	" " " " and potash	11.78	11.90	11.76
27	" " " " " "	14.11	13.95	13.94
28	" " " " " "	11.96	11.80	11.60
29	" " " " " "	9.09	9.06	8.90
30	" " " " " "	10.44	10.36	10.24
31	" " " " " "	13.09	13.08	12.63
32	" " " " " "	9.02	8.87	....
33	" " " " " "	9.58	9.60	....
34	" " " " " "	10.01	10.13	....
35	Dissolved animal bone	10.58	10.65	10.35
36	" " "	12.31	12.50	12.14
37	" " "	14.27	14.10	13.86
38	Complete	7.71	7.67	7.13
39	"	11.49	11.54	11.32
40	"	9.61	9.71	9.86
41	"	7.39	7.27	7.05
42	"	9.08	9.03	8.90
43	"	10.14	9.96	9.84
44	"	9.70	9.87	....

		Available official method. Per cent.	Available direct. Molybdate method. Per cent.	Citrate method. Per cent.
45	Complete, contains great deal tankage	5.27	5.31	....
46	"	8.51	8.39	....
47	" contains bone-black	6.46	6.64	....
48	" " blood	5.09	4.99	....
49	"	8.18	8.18	....
50	"	7.91	7.75	....
51	"	7.37	7.35	....
52	" contains great deal fish	7.44	7.59	....
53	"	9.38	9.36	....

The results by the citrate method were unexpectedly low. In the writer's hands this method had always given satisfactory results, even on low percentages. It is probable the low results were due to an excess of citrate, twenty to thirty cc. more having been added to each sample. This addition was unnecessary, and better results when more citrate was not added, leads to the belief that this additional citrate was the cause of the low results: No time remained, however, to confirm this opinion.

The results by the molybdate method were good. It was feared that the organic matter present would prevent the complete precipitation of the ammonium phosphomolybdate. To insure complete precipitation the samples were allowed to stand over night before filtering. In view of the results it is to be regretted that there was no opportunity for the determination of the time required for the complete precipitation of this salt under these conditions. It is probably not over two hours at 65° C.

Notwithstanding the oft-repeated statement that salts of organic acids and organic matter generally prevent the complete precipitation of ammonium phosphomolybdate, the molybdate method is used to determine soluble phosphoric acid in the presence of what organic matter may be dissolved by the water used in the extraction. In the Wagner method[1] for basic slag, we precipitate with molybdate solution in the presence of three grams of citric acid. Lorenz[2] precipitates in the presence of two per cent. of citric acid to prevent contamination with magnesia. Jüptner[3] uses as much as 100 grams of tartaric acid per liter of

[1] Principles and Practice of Agricultural Analysis, **2**, 78.
[2] *Ibid.*, **2**, 54.
[3] Abstract Experiment Station Record, **6**, 610.

molybdate solution to prevent the precipitation of iron and the separation of molybdic acid. The successful use of the molybdate method in these cases seems to warrant the conclusion that we are needlessly alarmed at the presence of, at least, some forms of organic matter in phosphate solutions.

The direct determination of the available phosphoric acid possesses several advantages. Only one determination is required instead of two as by the present method. The probable error is reduced one-half. We can also determine the soluble, reverted, insoluble, and total phosphoric acid in one sample and with one weighing where it now takes two samples and two weighings.

The saving of time effected by this method is of considerable importance in control and in factory laboratories, whether we use the citrate or the molybdate method, and it is hoped that the subject will receive further attention.

LABORATORY OF THE MARYLAND AGRICULTURAL COLLEGE,
COLLEGE PARK, MARYLAND.

NOTE UPON THE DETERMINATION OF NITROGEN IN FERTILIZERS CONTAINING NITRATES.

BY F. P. VEITCH.

Received September 4, 1899.

JOHN FIELDS[1] describes a modification of the Gunning method[2]. In this modification potassium sulphide alone is used in the place of potassium sulphate and sodium thiosulphate.

In Fields' hands the average difference between the methods is 0.02 per cent., the modification giving the higher average.

The writer has used this modification, carried out in a slightly different manner, with very satisfactory results. To the nitrate in the digesting flask are added thirty-five to forty cc. sulphuric acid containing thirty-four grams salicylic acid per liter. Allow to stand in the cold until the nitrate is dissolved. Add six or seven grams of finely broken potassium sulphide, heat over a low flame for fifteen minutes, then over the full flame until clear. Cool and distil as usual. The following are all the results I have obtained by this method.

[1] This Journal, **18**, 1102.

[2] U. S. Department of Agriculture, Division of Chemistry, Bulletin 46.

No.	Gunning. Per cent.	Modification. Per cent.	No.	Gunning. Per cent.	Modification. Per cent
608	{ 3.70 / 3.75	3.84	767	2.69	2.68
648	4.45	4.45	782	2.64	2.59
659	2.73	2.90	786	1.24	1.18
719	1.48	1.52	793	2.34	2.39
722	3.15	3.09	808	1.98	2.05
723	1.77	1.81	809	1.11	1.07
725	2.73	2.81	819	2.18	2.13
727	2.51	2.52	820	2.27	2.32
731	2.25	2.25	833	2.76	2.83
733	2.90	3.00	888	4.26	4.18
738	6.62	6.50	917	3.07	3.19
742	{ 5.99 / 5.75	{ 5.85 / 5.88	919	2.15	2.17
747	4.30	4.42	924	3.58	3.58
755	3.12	3.22	927	1.91	1.84
756	1.96	2.05	928	2.61	2.58
757	2.88	2.97	933	3.34	3.26
			941	2.90	3.04

Average di fference + 0.017.

The greatest difference between the methods is 0.17 per cent. and the average difference is 0.017 per cent. It is advisable to use a little more sulphuric acid in the digestion than is used in the Gunning method. There was no trouble with foaming, turning up the lamps being the only attention required. Time of digestion was about one and a half hours, being about a quarter of an hour longer than in the Gunning method. The modification seems to give as good results, requires fewer chemicals and less attention than the Gunning method, but requires a little longer digestion.

[CONTRIBUTION FROM THE LABORATORY OF AGRICULTURAL CHEMISTRY, OHIO STATE UNIVERSITY.]

NOTES ON TESTING SOILS FOR APPLICATION OF COMMERCIAL FERTILIZERS.[1]

BY H. A. WEBER.

Received September 28, 1899.

FOR more than twelve years of active service in connection with farmers' institutes, the writer endeavored to impress upon the farmers the necessity of a more rational method in the

[1] Read before the meeting of the American Association for the Advancement of Science, August 26, 1899.

use of commercial fertilizers, in order to avoid the useless expenditure of money for plant food which their soil did not require. The means for reaching this result were fully explained, but with few exceptions farmers could not be induced to make for themselves the ordinary field experiments, which alone could inform them of the needs of their soil, and indicate what fertilizers to buy for their fields.

In 1885 the writer instituted a series of experiments with soil in sewer pipes for the purpose of securing a method, by which these soil tests could be made for the farmers at the Ohio State University.[1]

The sewer pipes employed were fifteen inches in diameter and the amount of soil required was about 600 pounds. Subsequently it was found, that by the use of six-inch tiles, the amount of soil required could be reduced to seventy-five pounds with equally satisfactory results. The soils were collected in accordance with the following directions:

1. Never send a sample of soil from a field which without fertilizers is capable of yielding a full crop. On a soil of this nature commercial fertilizers will not pay.

2. Never send a sample from a field, which is not in a good, high state of cultivation; *i. e.*, which is not well drained, and where the soil when cultivated is not deep and pulverulent. Commercial fertilizers cannot counteract bad physical conditions of the soil.

3. Never send a sample from a meadow or clover sod, but always from fields that are under cultivation.

4. If a field is in a high state of cultivation and still fails to produce more than half a crop, there is good reason to believe that the soil is deficient in one or more of the essential ingredients of plant food. From such a field an average sample of soil should be sent for testing. In order to collect an average sample of the soil proceed as follows:

Begin at one end of the field and cross it back and forth at intervals of eight or ten paces until the other end is reached. While thus crossing dig a square hole with a spade, every eight or ten paces, down to the subsoil. Cut off a slice about two inches thick from the surface down to the subsoil and throw it

[1] See Fourth Annual Report, Ohio Agricultural Experiment Station, p. 231.

into a wagon-bed. Better still cut out a core of soil with a post-hole digger at each point. Avoid all local contaminations, as the droppings of cattle, piles of decaying vegetable matter, etc. Remove any trash from the surface by scraping before digging the hole, or sinking the post-hole digger. Also avoid all low places in the field, especially if they are filled with black soil or leaf mold. Thoroughly mix the soil thus collected and send not less than seventy-five pounds for testing. The test is made in the following manner:

Ordinary six-inch tiles are placed into large Wagner pots, which contain enough clean sand so that the top of the tiles will be on a level with the top of the pots. The whole is then filled with sand with the exception of the upper seven inches of the tiles. The sand is then thoroughly drenched with rain or condensed water. The empty portion of the tiles are next filled to within an inch of the top with the thoroughly mixed sample of soil, the fertilizer is added and incorporated with the upper portion of the soil by stirring, moistened if necessary, fifteen seeds of oats, spring barley, spring wheat, or other grain are distributed uniformly over the surface, and then covered with enough of the dry soil to bring the surface of the soil on a level with the top of the tiles. The six-inch tiles, to the depth of seven inches as described, will contain about ten pounds or five kilograms of soil.

Five miniature plots are thus prepared for each soil test. If Wagner pots are not available, a box eighteen inches deep with an opening in the bottom for drainage, and large enough to hold five of the tiles, may be employed. The sand surrounding the tiles is kept moist, by adding water once a week.

The amount and kind of fertilizer to be added to the five plots for each test are as follows:

PLOT 1. COMPLETE FERTILIZER.

	Gram.
Superphosphate	1.0
Potassium sulphate	0.5
Sodium nitrate	0.5

PLOT 2. COMPLETE MINERAL FERTILIZER.

	Gram.
Superphosphate	1.0
Potassium sulphate	0.5

PLOT 3.

	Gram.
Superphosphate	1.0
Sodium nitrate	0.5

PLOT 4.

	Gram.
Potassium sulphate	0.5
Sodium nitrate	0.5

PLOT 5.

No fertilizer.

As examples of this method of testing soils three experiments recently made will suffice.

The three soils were arranged in series of five plots and fertilized as already described. April 29 fifteen oat seeds were planted in each plot. Plants were up on May 3. No difference in the growth of the plants could be noticed before May 16. At this date plots 1, 2, and 3 were alike in all cases and were in advance of plots Nos. 4 and 5. The plots were thinned out to ten plants per plot. On May 18 each plant of plots 1, 2, and 3 had one side shoot, while plots 4 and 5 had none. The difference in growth between plots 1, 2, and 3 and plots 4 and 5 was very marked. On May 22 the plants of plots 1, 2, and 3 had two side shoots and were all practically alike, while plots 4 and 5, which again were alike, had no side shoots, were much smaller and less vigorous. On May 29 the same relation as to growth existed, except that in the case of soils 1 and 2, plot 2, which contained no sodium nitrate, showed nitrogen starvation, and remained in this condition to the end of the experiment. Plot 2 of soil 3 did not reveal nitrogen starvation in the slightest degree, but was in every respect equal to plots 1 and 2.

The plants of plots 4, which contained potassium sulphate and sodium nitrate, were not larger and not more vigorous at any time during the experiment, than those of plots 5, which contained no fertilizer.

From this it will be seen that soils 1 and 2 were deficient in phosphoric acid and nitrogen, while soil 3 was deficient in phosphoric acid only.

The following recommendations were made in accordance with these results: For soils 1 and 2, superphosphate 300 pounds

and sodium nitrate 100 pounds per acre. For soil 3, superphosphate 300 pounds per acre.

In the place of superphosphate a like amount of fine bone-meal was recommended for fall crops, like fall wheat and rye. In making the tests of soils in this manner it is not necessary to bring the plants to maturity, if time will not permit. Observations made on the growth of the plots during five or six weeks, will give sufficient data to interpret the needs of the soil.

The tests thus carried out are much less laborious than an analysis of the soil would be, and the chemist, who occupies a position, where the demands for soil analyses are frequently made by persons not properly informed in the matter, may often find this method of use in imparting that knowledge to the farmer, which will enable him to apply commercial fertilizers to his soil in a rational manner.

ON THE UNIVERSAL DISTRIBUTION OF TITANIUM.

By Charles Baskerville.

Received September 8, 1899.

THE universal distrjbution of titanium in the mineral and plant world is practically acknowledged. V. Roussel[1] found it in basalt; Aleksiejew[2] in certain clays. Holland[3] found it in certain igneous rocks. Dunnington[4] observed its occurrence in the soil of Albemarle County, Va.; later the same writer with McCaleb[5] found it in sixteen specimens of soil collected from different sections of the United States. Subsequently after having examined a large number of samples of soil collected from all parts of the globe Professor Dunnington[6] asserted its universal occurrence in the soils of the world.

W. A. Noyes[7] found it in a number of Arkansas minerals. Hillebrand has shown its presence in a large number of rocks and minerals collected by the United States Geological Survey. Wait[8] found it in the ashes of several plants and different kinds

1 *Ber. d. chem. Ges.*, **6**, 1417. *b*.
2 *Chem. Ztschr.*, Rep. 1896, 261.
3 *Chem. News*, **59**, 27.
4 *Proc. A. A. A. S.*, **34**, 132.
5 *Am. Chem. J.*, **10**, 36.
6 *Am. J. Sci.*, Dec. 1891; *Chem. News*, **65**, 65.
7 *J. Anal. Appl. Chem.*, **5**, 39.
8 This Journal, **18**, 402.

of wood, also in coals, bituminous and anthracite. Haywood[1] found traces in domestic strawberries and 0.1088 per cent. in the ash of wild strawberries (*Fragaria Virigiana*). Langenbeck speaks frequently of its occurrence in clays. It has been found by the writer rather widely distributed in the clays of this state.[2] While Roscoe and Schorlemmer state that "It does not appear to form part of the animal and vegetable kingdom," Wait[3] assumes that it is assimilated by plants. The writer[4] shows its presence in the ashes of peat. As the clay substance therein is comparatively small its presence can scarcely be attributed to that. F. Garrigon found traces in mineral waters.

No statement in the literature has been found of its presence being noted in the ashes obtained from the animal kingdom. The ash from incinerated fresh beef, beef bone, human flesh, and bone free from dirt, have been examined in this laboratory with the following results: Beef bone 0.0195 per cent., beef flesh 0.013 per cent., human bone[5] a trace, human flesh[6] 0.0325 per cent. titanic oxide.

A private communication from Dr. J. L. Howe concerning the work of some of his students states that "Toole found titanium in abundance in dead bones, but only traces in fresh bone and muscular tissue, though traces were undoubtedly there." Dr. C. E. Wait in a letter of recent date writes: "Since my note on titanium was published a year or so ago, I have made an examination of a large number of bodies and I believe that element was found in nearly all of them. I have made a large number of estimations of titanium in vegetable bodies, and later took up the examination of animal flesh and bone, and the last piece of work along that line was the examination of human excretory products."

The universal distribution of titanium in all forms of living and dead matter may now be regarded as settled. While no opinion is hazarded by the writer upon the rôle played by

1 This laboratory. Work unpublished.

2 See "Clay Deposits and Clay Industry in N. C." Bulletin 13, N. C. Geological Survey, by Dr. H. Ries.

3 *Vide supra.*

4 This Journal, 21, 706.

5 A true rib and clavicle.

6 Pectoral muscles, *latissimus dorsi* and *gluteus maximus*. I am indebted to Dr. C. S. Mangum, of this University, for kindly dissecting out these samples.

titanium in animal and vegetable growth, it is hoped that Dr. Wait's work will throw some light upon the subject. Doubtless had we as delicate and covenient tests for the other less common elements we should find their occurrence as widespread. Thus the asseverated belief of Hillebrand in the universal occurrence of all the elements in the earth's crust is extended.

Titanium was determined by Weller's well-known method as modified by W. A. Noyes, Dunnington, and Hillebrand.

UNIVERSITY OF NORTH CAROLINA.

THE RELATION OF PHYSICAL CHEMISTRY TO TECHNICAL CHEMISTRY.[1]

BY WILDER D. BANCROFT.

Received October 2, 1899.

STUDENTS ask me often what use physical chemistry can be to them if they are going into technical work and, once or twice, a manufacturer has said to me that "of course, physical chemistry has no practical usefulness." It is this idea, that physical chemistry is not a necessary part of the technical chemist's equipment, which I wish to combat. Let me warn you in advance, however, not to take anything that I shall say as an argument in favor of substituting a study of physical chemistry for a study of organic or inorganic chemistry. Nothing is farther from my thoughts. A good working knowledge of inorganic and organic chemistry is absolutely essential to the man who is going to use his physical chemistry either for purely scientific purposes or for technical purposes.

To understand the usefulness of physical chemistry to the manufacturer, it is necessary to ask what the manufacturer needs. He is interested in the discovery of new and useful compounds, and in the improvement of methods for making compounds already known. The discovery of new and useful compounds may be left, for the present, to the man who is an inorganic or an organic chemist, pure and simple: it is his especial province. What I wish to emphasize is that this is, as a rule, a matter of secondary importance. There are very few manufacturers who make their profits entirely from the sale of a compound which they alone have the right to make. The

[1] Revised from a paper read before the American Chemical Society at Columbus, September 21, 1899.

American chemist makes and sells compounds which others also make and sell. He has to face competition in this country and competition from abroad. His chance of making money, apart from advantages of position, lies in the use of better methods, in getting a larger yield at the same cost or in getting the same yield at a less cost. How to do this is the problem of the manufacturer and no course of education can be considered really satisfactory which fails to take this into account.

Having found out what is needed, the next question is how to get it. To my mind, specialization and research work in organic or inorganic chemistry do not give the proper training. Let us consider for a moment what sort of training a man gets from a study of organic chemistry. Organic chemistry is at present the chemistry of new compounds. The object of a thesis in organic chemistry is to make new compounds, or to bring out more clearly the relation between two or more compounds. A man specializing in organic chemistry gets a training in manipulation and in methods of making new compounds; in addition, he increases his knowledge of chemistry and of chemical phenomena. This work qualifies him to meet one of the requirements of the manufacturer; he can make himself valuable in discovering new and useful compounds, and in working out new methods of making compounds already known. His training has not been of a nature to make himself especially valuable in improving methods. In ninety-nine cases out of a hundred, the man doing research work in organic chemistry is interested in making a reaction go, or in getting enough of any given substance to go on with. While he would rather get a ninety per cent. yield than a ten per cent. yield, he is too much interested in the substance that he is getting, or in the one that he is going to make from that, to be willing to spend much time in a possibly fruitless effort to increase the yield. By this, I do not mean to imply that the organic chemist has necessarily erred in his choice of goal; he has modern organic chemistry to show as a result. I wish to emphasize the fact that the ideals of the organic chemist are not the ideals of the manufacturer, and that a training in organic chemistry is not the best training for a technical chemist. I have laid stress on the training in organic chemistry rather than on the training in inorganic chemistry, because

organic chemistry rather overshadows inorganic chemistry in most of our universities and colleges. It is, however, equally clear that inorganic chemistry, as now taught, does not offer the ideal training for a technical chemist.

Let us now turn to physical chemistry. If organic chemistry be called the science of new compounds, physical chemistry will have to be defined as the science of methods. The physical chemist studies the reaction and not the end products. The organic chemist, or the inorganic chemist, as the case may be, tells him what the initial and final products of a reaction are, and the physical chemist then proceeds to study that reaction qualitatively and quantitatively, with special reference to such factors as initial concentration, temperature, solvent, pressure, electrical stress, and time. He does more than this. He correlates his facts and draws conclusions from them, so that it becomes possible to generalize from one reaction to all reactions. It is here that the value of physical chemistry as a training for the technical chemist comes in. It is no longer necessary to work each step of reaction out by itself. We can profit by what we have learned with regard to other, apparently dissimilar, reactions. A single instance will make clear what I mean. A certain reaction gives a fifty per cent. yield under certain conditions, and the question comes up whether changing the temperature will help matters. The man who has not studied his physical chemistry will be forced to make one experiment at a higher and one at a lower temperature in order to determine whether raising or lowering the temperature will increase the yield. If there happens to be a secondary reaction taking place, this may mask the primary reaction, and even cause false conclusions to be drawn. The man who has studied his physical chemistry finds out whether the reaction absorbs or evolves heat, and can then predict the effect of a change of temperature. If the actual result does not tally with that expected, he knows that there must be some secondary reaction taking place, and he will then proceed to minimize this. A most striking instance of this waste of money due to lack of theory is to be found in the history of the blast-furnace.

I am indebted to Dr. H. W. Wiley of the Agricultural Department for the following illustration of the practical appli-

cation of a fact that appears at first sight to have theoretical interest only. It was found recently in California, after a very dry summer, that beet-sugar could not be made in the usual way, owing to the presence of a relatively large amount of colloids in solution. Mr. E. C. Burr took advantage of the fact that colloids diffuse much less rapidly than crystalline substances, and solved the problem by shortening the time of extraction. It is evident in this case that a man with no theory to guide him might have experimented a very long time before finding the right conditions.

Even in cases where there is no theory applicable as yet, a training in physical chemistry will prove invaluable. In many industries, the color industry for instance, the physical state of a preparation is of great importance. While we cannot at present predict the conditions necessary to produce a product having the required properties, the man who has been trained to vary one factor at a time, and to note the effect of that change, will reach the goal more quickly than the inorganic or organic chemist who, quite unconsciously, allows two or more factors to vary simultaneously. If any one doubts this, let him look up the literature on the allotropic forms of the elements, or on the transformation of isomers and he will see how little attention has been paid in the past both by the inorganic and organic chemist to the conditions affecting equilibrium.

A point of great interest, technically, is the question whether a reaction will run on a large scale as well as on a small one. Many factors, such as stirring, filtration, keeping the temperature constant, etc., are often negligible in the laboratory and yet become of vital importance when the work is carried out on a large scale. Here again the training of the physical chemist should stand him in good stead. Having worked out the conditions under which the reaction goes properly, he is in a position to tell whether the disturbing factors are of such a nature as to become serious when the quantities are increased. In connection with this, I wish to call your attention to the importance of determining the conditions under which the reaction does not go as well as those under which it does go. Experimenting on a large scale is only possible to a limited extent owing to the expense involved and it should never be necessary

to fail twice in the same way. While it is not always possible to do on a large scale what can be done on a small scale, there is something wrong when a chemist cannot repeat in the laboratory the results he has obtained in the factory.

A training in physical chemistry means, or should mean, a training in methods and in the application of general principles to particular cases. A physical chemist has two advantages over another chemist when it comes to attacking a technical problem. He has had previous practice along that line, and he has his general principles or laws to guide him so that he does not need to grope aimlessly, waiting for a fortunate accident. It is thus clear that the young man who has studied physical chemistry should be more serviceable to the manufacturer than the young man who has not; but we then come face to face with the question whether we so teach physical chemistry that our students are really as superior to other students as they ought to be. I am afraid that this is not the case as yet, and that the fault lies in our teaching.

Personally, I do not believe in the teaching of technical chemistry as technical chemistry. To my mind, a comparison of German results with English results shows very conclusively that the best way to teach technical chemistry is to teach scientific chemistry. There are, however, many ways of teaching scientific chemistry and I am quite willing to admit that we do not yet teach physical chemistry in the best possible way. Physical chemistry, in its present form, is a development of the last fifteen years. Although lectures on this branch of chemistry are given at most of the universities in this country, chairs have been established only at Wisconsin and at Cornell. Under these circumstances, it will be profitable to consider, for a moment, what our shortcomings are and how they are to be remedied.

The chief criticism that I should make on all teachings of physical chemistry, including my own, is that we fail to emphasize the fact that the laws of chemistry are tools to be used rather than things to be remembered. Everyone who has worked in a laboratory appreciates the wide gulf that exists between knowing a thing and being able to use that knowledge. The ability to use knowledge comes from practice and our laboratory courses

should be extended so as to include practice in applying the general principles that have been learned. I use the word "applying" in contradistinction to the word "demonstrating" because I do not mean laboratory work supplementing the lectures. That we now have. We give our students practice in freezing-point, boiling-point, reaction velocity, conductivity determinations, etc., etc. These experiments are intended to familiarize the student with the method and the apparatus, to enable him to test the general principles, and thus to make him understand and remember them; but these experiments do not teach him how to apply the general principles in concrete cases and I think it is more than probable that a student might do all these and yet not prove himself markedly superior in technical work to a man who had not had these advantages. It seems to me that the training is bound to be incomplete unless, in addition, each man takes up some method, not necessarily a technical one, and studies that in detail, finding out how the yield can be increased, why it can be increased, and how that could have been discovered with the minimum expenditure of time. After such a drill, the student begins to appreciate that the theoretical generalizations are meant for use; he also learns what will be of immense service to him in case he goes into technical work, that it is often possible to obtain an enormously increased yield by relatively slight changes in the conditions of the experiment. We have had an instance of this at Cornell during the past year. One of my students took up the question of the electrolytic reduction of potassium chlorate and had no difficulty in increasing the efficiency from below ten per cent. to ninety per cent. and upwards. This particular reaction will never be of any technical importance because potassium chlorate is now made on a large scale by the electrolytic oxidation of potassium chloride. The training obtained by determining the effect of the different factors on the percentage yield will stand that man in good stead, no matter what problem in electrochemistry he may be called upon to solve. Another problem which has been taken up at Cornell during the past year is the question of the best method of separation by fractional distillation. Although these experiments are not yet finished, we have already obtained results

which are distinctly superior to any that have been reached previously.

These two instances are cited to show the feasibility of the plan that I am advocating. There is no limit to the amount of work that can be done along this line. For instance, it would be most profitable to take any one of the little laboratory manuals in organic chemistry and work through the experiments with a view of improving the conditions. From a cursory inspection, I should say that there are very few cases in which an increased yield could not be obtained. The advantages of such a drill would be very great whether the student was going into technical work or intended to devote himself to pure science.

There is no reason, save lack of time, why the student should not be given a training in the application of general principles to methods. This lack of time will disappear as soon as teachers, students, and manufacturers appreciate the importance of such work. There is one other point in which the physical chemistry is still seriously defective. The majority of the papers on physical chemistry published every year deal with so-called dilute solutions, solutions containing less than two per cent. of one of the components. Practically all of our quantitative theory of solutions fails to apply to ninety-six per cent. and over of the possible field. We have accomplished a great deal inside the narrow limits we have set ourselves, but it is obvious that we are handicapped seriously in the application of physical chemistry to technical chemistry so long as we discuss quantitatively only such solutions as do not occur in technical work. Quite apart from the technical bearing, we can never obtain for physical chemistry its proper title as the science of chemistry until we can say that we do cover the whole field.

The whole matter can be summed up in a few words. A good training in physical chemistry is the best possible preparation for a technical chemist; but the ideal training in physical chemistry cannot be obtained until we have broken away from the shackles of 'ideal' solutions and until we have introduced laboratory work showing the application of general principles to methods.

CORNELL UNIVERSITY.

APPARATUS FOR THE ANALYSIS OF ILLUMINATING AND FUEL GASES.

By Geo. E. Thomas.

Received July 21, 1899.

THERE are many difficulties in the manipulation of the various forms of apparatus now employed for the analysis of illuminating and fuel gases. Much danger of loss is incurred in some methods of procedure incident to the repeated connecting and disconnecting of apparatus, while the size of others renders them inapplicable for easy transportation; also the necessity of frequent cleansing in some forms and the fragility of the material due to peculiarities of construction offer many obstacles in this line of chemical analysis. With these objectionable features in mind and with the desire to construct a piece of apparatus compact and efficient for technical work, the production of the form represented by figure 1 was undertaken, believing that there would be a demand for it.

The apparatus here described consists of a burette and leveling tube joined by rubber and capillary glass tubing with bottles, each of which is provided with a funnel. The dimensions are sixteen inches long by fifteen inches high. The burette is graduated to 100 cc., forty in whole dimensions, represented by the bulb 3, and the remainder in fifths of the same and is supplied with platinum terminals 4 and 5, about one-half inch from the top; it is connected with the leveling tube 7 by rubber tubing and is filled with water acidulated with sulphuric acid to decrease the solubility of the carbon dioxide in the water. The burette is joined to the absorbing bottles 15, 16, and 17 and the storing bottle 18 by the capillary tube *e* and the capillary T tubes 11, 12, 13, and 14 having stop-cocks 19, 20, 21, and 22 connected by rubber tubing; 14 is provided with a plug 34. The funnel tube of each bottle serves for the exit of liquid from below. Tubes 23, 24, and 25 are supplied with stop-cocks *b*, *c*, and *d*, none being required on the last tube as bottle 18 is used only for storing. Bottle 15 is filled with a solution of caustic potash; larger surface to increase the absorption is obtained by the use of glass tubes. Bottle 16 contains water saturated with bromine, while 17 holds the phosphorus covered with water, being

Fig. 1.

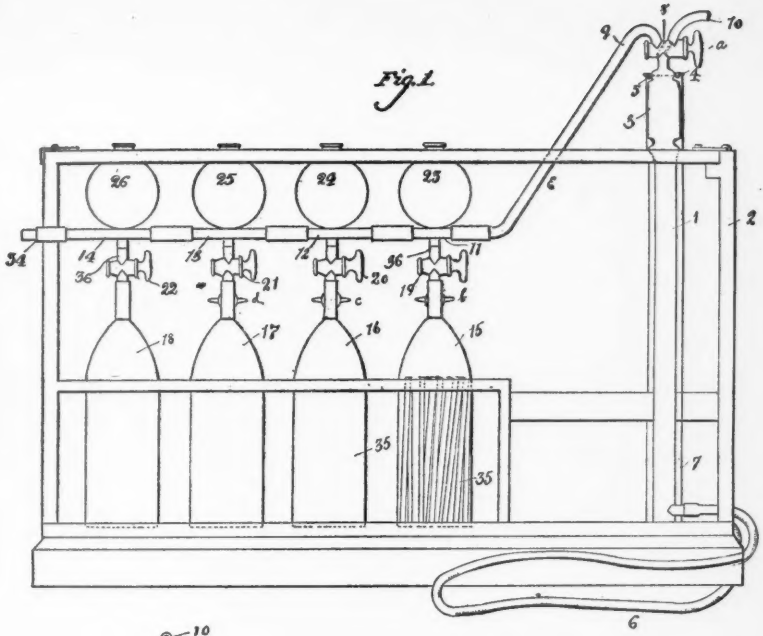


Fig. 2.

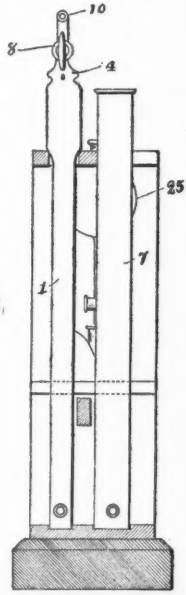
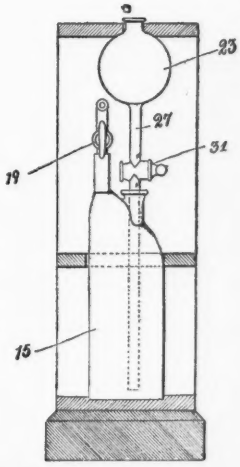


Fig. 3.



protected from the action of the light by a black cloth. Bottle 18 is filled with water, as it is only used for storing gas.

Before beginning the analysis stop-cocks *b*, *c*, and *d* are opened. Upon opening the three-way cock *a* and raising the leveling tube 7, the burette is filled with water, also the capillary tube 10, which, after closing *a*, is connected with the gas supply. By lowering 7 and again opening *a*, gas is drawn into the burette; 100 cc. are measured after allowing the sides of the burette to drain. Communication is now opened between the burette and bottle 15 by means of stop-cocks *a* and 19; raising 7 forces the gas through the capillary tubing into 15. This operation is repeated three times, always allowing the water in the burette just to enter the capillary system finally bringing the solution to the mark. 19 is now closed, and the water in the burette and tube 7 is brought to the same level before closing *a*. After draining, the loss in volume is observed. The same process is carried out substantially as described for the absorption of the illuminants and oxygen by bromine and phosphorus in bottles 16 and 17 respectively, precaution being taken to completely absorb the bromine vapors in the gas after the elimination of the illuminants, by potassium hydroxide in bottle 15 and allowing the fumes to almost disappear after the absorption of the oxygen before returning the gas to the burette. Thus the carbon dioxide illuminants and oxygen are determined, after which the remainder of the gas is stored in bottle 18 prior to exploding portions with air, or air and oxygen. These direct absorptions are followed by the introduction of about 80 cc. of air into the burette through the tube 10. This is collected before the gas because of the coarser graduation in the bulb, very accurate measurement being required in this operation. By opening *a* and stop-cock 22 and lowering 7, about 15 cc. of gas are drawn into the burette. Now 22 is closed and 21 opened, thereby filling the capillary tubing to 8 with water from 17 to insure an accurate determination. Now close *a*. After draining, make a reading of the volume, and after opening communication at *a* and 19 pass the gas and air into 15 to obtain a thorough mixing, after which it is returned to the burette, the solution being brought to the mark; 19 is closed and the tubing filled as before with water from 17. Close *a* and lower 7 to reduce the

pressure. Clamp or preferably bend the rubber tubing and introduce into a slit in the side of the frame, thereby obtaining a perfect water seal, allowing no opportunities for loss when the mixture of gas and air is exploded.

Contact is now made between the platinum terminals and an induction coil attached to a battery, a spark produced therefrom igniting the mixture. A flame is seen suddenly to run down the burette, the explosion being very mild, due to the peculiarity in construction of the burette, carbon dioxide and water being the products of combustion. The gas is now allowed to assume the temperature of the room after the pressure on the tube is released. The contraction is observed, also the amount of carbon dioxide produced by absorption in 15, and the excess of oxygen in 17, the same precautions as to filling the system with water after each determination being strictly adhered to, together with the suggestion that the last time the gas is passed into 17 for the separation of the oxygen, that water from the burette be forced through the capillary system into 17 to insure complete absorption.

From the data thus obtained, it is possible to calculate the amount of hydrogen, carbon monoxide, and methane by following the well-known formulas in Sutton's "Volumetric Analysis."

(1)

$C = 1\frac{1}{2}x + \frac{1}{2}y + 2z$ $\quad x = A - D$ $\quad C =$ Contraction

$A = x + y + z$ $\quad y = \frac{3A - 2C + D}{3}$ $\quad A = a - n =$ Vol. of gas $- n$

$D = y + z$ $\quad z = \frac{2C - 3A + 2D}{3}$ $\quad y =$ Carbon monoxide

$z =$ Methane

$x =$ Hydrogen

$D =$ Carbon dioxide

$n =$ Nitrogen.

(2)

$B = \frac{1}{2}x + \frac{1}{2}y + 2z$ $\quad B =$ Oxygen consumed

$x = A - D$ $\quad A = a - n =$ Volume of gas $- n$

$y = \frac{3D - 2B + A}{3}$ $\quad n =$ Nitrogen

$z = \frac{2B - A}{3}$ $\quad D =$ Carbon dioxide.

As the excess of oxygen after the combustion is absorbed by phosphorus in bottle 17 an explosion with hydrogen is avoided. What remains after this process is completed is the nitrogen in the air plus the nitrogen in the gas; a direct determination of the latter is thus made possible.

If it should be desired to employ this apparatus for fuel gas analysis, bottles 17 and 18 can be filled with a cuprous chloride solution, using a layer of petroleum in the funnels to prevent the air having an oxidizing action upon the copper solutions. By the use of two solutions a more accurate determination is made as it is well known that one cuprous chloride solution repeatedly used is not a satisfactory reagent for the absorption of carbon monoxide. It has been found that a lubricant is absolutely essential for success with this as with similar forms of apparatus. The one mentioned in this Journal, **20**, 678, is recommended but for the bottle containing bromine, vaseline is better adapted. A uniform temperature should be maintained in the laboratory as the burette is not water-jacketed. The apparatus described appears to have many advantageous features beside its compactness, which is certainly desirable, for ample space is allowed above the funnels for an induction coil and small battery, making the complete outfit to go in a case sixteen by seventeen inches. The T tubes being separate and 36 having a plug, 34 affords opportunity for rapid and easy cleansing of the capillary system. After the gas is once collected, there is no possibility of loss as it remains in the apparatus until the analysis is complete and, if necessary, several confirmatory explosions are made. All the parts are readily disconnected and sections when broken can be easily replaced. With the exception of 17, disconnection is only required in case of accident, as the other bottles may be replenished by forcing the liquids into the funnels, siphoning off and fresh solutions added. Direct explosion in the measuring burette is an advantage as it eliminates the necessity of an extra bottle for that purpose. Less than an hour is required for the completion of an analysis by this method and the results obtained have been eminently satisfactory.

THE DETERMINATION OF GRAPHITIC CARBON IN CAST AND PIG IRON.

By Allen P. Ford and I. M. Bregowsky.

Received October 10, 1899.

GRAPHITIC carbon in cast iron is usually determined by dissolving the iron in dilute nitric acid and estimating the residual graphite by combustion, either by the wet or the dry-method; or by drying and weighing direct on weighed paper filters, burning off the graphite and paper and subtracting the weight of the ash and silicon.

The combustion method, while generally considered to be the most accurate, requires considerable time, great care, and close attention, and even then failures are common. For these reasons it is not well adapted to the requirements of a laboratory in connection with foundries and manufacturing plants, where time is an important consideration. In these cases the weighed paper method is generally resorted to, though, in a less measure, it is open to the same objections as the combustion method. Aside from the time required for two dryings in the air-bath of an hour to an hour and a half each, and three weights with time for cooling each time, one must take care that the paper is thoroughly dried without being charred and that no loss occurs in the transfers of the filter-paper from funnel to weighing-bottle and back again.

Under the conditions there appeared to be no reason why the graphite could not be filtered, burned off and determined by direct loss on a Gooch. At first, in order to make the experiment inexpensive, a porcelain Gooch was used, but it was found to be very difficult to get sufficient heat through the thick and comparatively clumsy porcelain crucible to burn off all the graphite. Furthermore, when the attempt was made to ignite the crucible and freshly prepared asbestos felt previous to filtering the graphite, the bottom of the crucible usually broke off. Being convinced that the method was practicable, however, a platinum Gooch was obtained and this difficulty overcome.

Then much annoyance was experienced in filtering. When the iron contained much silicon, enough would separate with the graphite to clog the asbestos felt, and hinder the filtration, sometimes even making it impossible. As hydrofluoric acid had

been used to eliminate the silicon in the determination of manganese, it was tried for the same purpose in the graphite. The result was very satisfactory.

The silicon was disposed of, and the filtration made easy and rapid. Also many determinations can be made on the same asbestos felt while in the first case only one could be made without changing the felt. It remained to be ascertained whether the hydrofluoric acid had any effect on the accuracy of the result in any way.

To determine this point a number of analyses were made in pairs, in one case with hydrofluoric acid and in the other without. The results checked closely and proved that the hydrofluoric acid did not affect the accuracy of the method.

Determinations by this method with and without hydrofluoric acid were also checked with duplicate samples by the paper method. The results agreed closely. In fact, in some cases where a number of determinations were made on one sample, those by the Gooch showed more uniformity than those by weighed papers. This was attributed to the fact that the weight of the paper may vary before and after filtering. The details of the method are as follows :

One gram of pig or cast iron is dissolved in nitric acid (sp. gr. 1.12), better without boiling. When solution is complete, or nearly so, a few drops of hydrofluoric acid are added, more or less according to the amount of silicon present, and boiled a short time.

This boiling will drive off the hydrofluoric acid or nearly so, and insure complete solution of the iron. The acid solution is then diluted with four or five times its volume of water and filtered by slight suction on a Gooch.

Care should be taken in the selection of asbestos for this purpose. It should be digested in hydrochloric acid and, in case of a freshly prepared felt, it should be ignited until there is no further loss of weight, before the graphite is thrown on it.

After the first determination it is only necessary to wash it each time. This is advisable as each ignition has a tendency to open up the felt, and the washing under suction settles the asbestos down in place and makes as good a filtering medium as in the first determination.

It also washes out any fine particles of asbestos which might possibly be lost in the subsequent ignition. After washing with hot dilute hydrochloric acid and hot water, the crucible with contents is dried an hour or an hour and a half at 120°, the length of time it is dried depending somewhat on the amount of graphite.

The crucible is then cooled, weighed, the graphite burned off, and the crucible cooled and weighed again, the difference between the two weights being the graphite.

The advantages of the method are, a very considerable saving of time, less liability to error by doing away with the paper filter, and the avoidance of the necessity of such close attention since a variation in the temperature of the air-bath that would be fatal to a paper filter will not affect the graphite. Also, in the absence of the paper, the air-bath can be run at a much higher temperature, thus making the thorough drying of the graphite certain.

A few experiments were made with samples containing about three per cent. of graphite to determine the loss by boiling in nitric acid.

It was found that when using nitric acid (sp. gr. 1.20) and boiling from one to three hours, there was a loss of from 0.16 per cent. to 0.32 per cent. In using nitric acid (sp. gr. 1.12), however, the graphite was apparently not affected when boiled one hour after the iron was dissolved and the solution ready to filter.

In some cases there was a loss of a few hundredths of a per cent. and in others a slight gain. In all cases, however, the difference was within the limit of the legitimate error of manipulation and simply showed that there was no oxidation of the carbon by the nitric acid.

From these experiments it was pretty clearly demonstrated that there is no loss of graphite when using nitric acid (sp. gr. 1.12), even if the boiling is continued much longer than necessary.

REPORT OF THE COMMITTEE ON COAL ANALYSIS.

To the President and Members of the American Chemical Society:

SOME time ago a preliminary report of this committee was presented to the society.[1] The committee desire, now, to present the following as their final report. In doing this, they are well aware that more experimental work on some points in the report is very desirable. But no member of the committee is able, at present, to give much further time to the matter and it is felt that nothing can be gained by further delaying the report.

In presenting the report the committee wish to express their thanks to those who have so kindly aided the committee by their criticisms and otherwise; especially to Mr. W. H. Clingerman, of the Frick Coke Co., who furnished samples of the Pennsylvania coking coals; to Mr. R. C. Hills, of the Colorado Fuel and Iron Co., of Denver; to Mr. William Kent, of the *Engineering News*; to Mr. William Glenn, of the Baltimore Chrome Works; to Professor N. W. Lord, of Ohio State University, Columbus; to Mr. G. L. Heath, of the Calumet and Hecla Smelting Works, South Lake Linden, Mich; to Mr. Geo. H. Eldridge, of the U. S. Geological Survey; and to Messrs. R. W. Atkinson and A. J. Atkinson, of Cardiff, Wales.

METHODS OF ANALYSIS.

1. *Sampling.*—In sampling from cars proceed as follows: Beginning at one corner of the car, drive a scoop-shovel vertically down as deep as it will reach. Bring it out with all the coal it will hold and throw into a cart or wheelbarrow. Repeat, taking six scoopfuls along one side of the car, at equal intervals, six through the center and six along the other side. Place the coal taken on a close, tight floor. Break all lumps larger than an orange. Mix by shoveling it over on itself, back and forth. Quarter, and reject opposite quarters. Break finer, as may be necessary, and continue to quarter down till a sample is obtained small enough to go into a quart fruit jar and having no pieces larger than one-fourth inch cube. The sample may, with advantage, be run rapidly through a mill which will break it to

[1] This Journal, 20, 281.

the size mentioned. Transfer to the jar and make sure the latter is sealed air-tight before it is set aside. All of these operations should be conducted as rapidly as possible to guard against any change in the moisture content of the coal.

Modifications of this method of sampling will, of course, suggest themselves, and in some cases will be necessary. When possible, a more representative sample may be secured by taking shovelfuls of the coal at regular intervals during the loading or unloading of the car. In any method of sampling, two conditions must be insisted on; the original sample should be of considerable size and thoroughly representative, and the quartering down to an amount which can be put in a sealed jar should be carried out as quickly as possible after the sample is taken. Unless the coal contains less than two per cent. of moisture, the shipment of large samples in wooden boxes should be avoided.

In boiler tests, shovelfuls of coal should be taken at regular intervals and put in a *tight, covered* barrel, or some air-tight covered receptacle, and the latter should be placed where it is protected from the heat of the furnace.

In sampling from a mine, the map of the mine should be carefully examined and points for sampling located in such a manner as to fairly represent the body of the coal. These points should be placed close up to the advancing crescent-shaped front of the workings. Before sampling, make a fresh cut of the face from top to bottom to a depth which will insure the absence of possible changes or of sulphur and smoke from the blasting-powders. Clean the floor and spread a piece of canvas to catch the cuttings. Then, with a chisel, make a cutting from floor to roof, say three inches wide and about one inch deep. Do not chisel out the shale or other impurities that it is the practice at that mine to reject. Measure the length of the cutting made but do not include the impurities in this measurement. With a piece of flat iron and hammer break all pieces to quarter inch cube or less, without removing from the cloth. Quarter down and transfer to a sealed bottle or jar. For the "run-of-mine" sample, samples taken at several points in this manner should be mixed and quartered down. If the vein varies in thickness at different points, the samples taken at each point should correspond in amount to the thickness of the vein. For instance, a small

measure may be filled as many times with the coal of the sample as the vein is feet in thickness. Should there appear differences in the nature of the coal, it will be more satisfactory to take, in addition to the general sample, samples of such portions of the vein as may display these differences.

For analysis quarter down further to about 100 grams. Run this portion through a mill which admits of quick grinding with little exposure to the air. A coffee-mill set to grind as finely as possible will answer. The grinding of 100 grams is recommended because less water will be lost than if a smaller sample is ground.

When an accurate determination of moisture is required and especially with coals high in moisture a portion of this coarsely ground sample must be transferred at once to a tightly stoppered tube for use in determining moisture.

Grind twelve to fifteen grams of the remainder moderately fine in a porcelain or iron mortar and transfer to a tightly corked tube for use in other determinations than that of moisture.

The committee wish to urge very strongly upon chemists and engineers the importance of careful sampling and of *careful treatment of the samples* in order to secure reliable results, especially in the determination of moisture.

That other factors must also be taken into consideration, in some cases, is illustrated by the following occurrence, cited by Mr. R. C. Hills.

"A railway manager had a car of coal from the South Platte field sampled and got me to analyze it. The sample was taken in the summer time and although a lignite, containing, usually, twelve per cent. of moisture, it only afforded ten per cent. Later on he concluded to try a car from the Franceville field, also lignite, affording in the summer time about fifteen per cent. of moisture. The sampling was done in the latter part of November and I obtained about twenty-one per cent. out of it. In both cases determinations were made elsewhere. The result was great injustice to the Franceville operators and to the best interests of the railway. Evidently there was accordance between the chemists on each sample but had the conditions under which the samples were taken been reversed each would have varied several units from the values found."

A car-load of many western coals may lose several hundred

pounds of moisture daily while standing on the track and the same coal may lose several per cent. of moisture by standing for a few days or weeks in a loosely stoppered bottle.

2. *Moisture.*—Dry one gram of the coal in an open porcelain or platinum crucible at 104°–107° for one hour, best in a double-walled bath containing pure toluene.[1] Cool in a desiccator and weigh covered.

With coals high in moisture, and in all cases where accuracy is desired, determinations must be made both with the coarsely ground and with the powdered coal. When, as will usually be the case, more moisture is found in the coarsely ground than in the powdered coal, a correction must be applied to all determinations made with the latter. Thus, if one per cent. more of moisture is found in the coarsely ground sample a total of one per cent. must be subtracted from the quantities of the other constituents as determined with the powdered sample. Or, in the form of a rule: Divide the difference in moisture by the per cent. of other constituents than moisture as found in the powdered coal. Multiply the per cent. of each constituent as found in the powdered coal by the quotient and subtract the resulting product from the amount of the given constituent.

Thus, suppose the results of an analysis give:

	Coarsely ground coal.	Powdered coal.
Moisture	12.07	10.39
Volatile combustible matter	.....	34.25

then the correction factor will be

$$\frac{12.07 - 10.39}{100 - 10.39} = \frac{1.68}{89.61} = 0.0187$$

and the true per cent. of volatile combustible matter will be

$$34.25 - (34.25 \times 0.0187) = 33.61.$$

It is possible that volatile combustible matter and ash may be determined with the coarsely ground coal without serious error but we have not enough data at our command to warrant such a recommendation.

The toluene bath is recommended for convenience, but any other bath at the proper temperature will answer equally well. In all cases recorded below, the coals gained in weight, probably

[1] Victor Meyer: *Ber. d. chem. Ges.*, 17, 2999.

from oxidation, after one hour's heating, so that longer heating is not only unnecessary but undesirable. A higher temperature appears also to be undesirable (see below).

The results of Dr. Hillebrand as to the loss of moisture *in vacuo* over sulphuric acid, recorded in our first report, have been confirmed by the following results obtained by Mr. N. M. Austin at the Rose Polytechnic Institute. The results are in most cases, averages of from two to six determinations.

No.	Toluene. First hour. 107° C.	Toluene. Second hour. 107° C.	Xylene. First hour. 138° C.	Xylene. Second hour. 138° C.	In vacuo over sulphuric acid. Seven hours.	In vacuo over sulphuric acid. Twenty-four hours.	In vacuo over sulphuric acid Sixty-four hours.
1	0.97	0.92	1.03	0.98	1.17	....	1.18
2	4.55	4.61	4.60	4.56	4.69	....	5.05
3	1.39	1.27	1.27	1.15	1.46	1.45	1.56
4	1.31	1.29	1.27	1.20	1.36	1.38	1.39
5	1.00	0.97	0.97	[illegible]96	1.10	1.14	....
6	1.44	1.31	1.22	[illegible]15	1.46	1.49	1.56
7	14.53	14.23	14.85	14.[illegible]8	14.91	15.47	15.25
8	8.43	8.21	8.31	8.[illegible]2	8.91	8.90	8.95
9	1.34	1.32	1.23	[illegible]	....	....	....
10	10.50	....	....	[illegible]	11.04	11.55	....

While it is evident that more water, and doubtless, more nearly the amount of water actually present, can be obtained by drying for twenty-four hours *in vacuo* over sulphuric acid than by drying for one hour at 104°–107°, the committee are not prepared to recommend so radical a departure from common usage for general adoption. They believe that drying *in vacuo* should be used when great accuracy is desired and in all cases where the determination is to be combined with an ultimate analysis, but that so long as the conditions of sampling are not more carefully controlled than at present, the difference between the two methods (average 0.37 per cent.) is not great enough to justify the general adoption of the new method.

The small difference found between the determinations at 107° and those at 138° (0.03 per cent. more at the lower temperature on the average) indicates that a variation of several degrees in the temperature of the bath will have no appreciable effect on the determination, provided the temperature is above the boiling-point of water.

A series of comparative determinations made in porcelain and platinum crucibles gave slightly higher values, on the average 0.12 per cent., in the porcelain. This was probably due to the greater depth of the platinum crucibles, causing the moisture to diffuse away more slowly.

For coals containing less than two per cent. of moisture, satisfactory results can be obtained by drying for twenty-four hours in a watch-glass over sulphuric acid, at atmospheric pressure (C. B. Dudley). For lignites, and for coals containing a high per cent. of moisture, the method is not satisfactory.

The following determinations made by the chairman of the committee demonstrate the impossibility, under some laboratory conditions, of grinding coal in a mortar without serious loss of moisture. In these determinations about 100 grams of the coal were ground in a coffee-mill and then ten to twenty grams of this coarsely ground coal were ground as quickly as possible in an iron mortar and transferred at once to a stoppered tube.

		Ground once in a coffee-mill.		Ground twice in a coffee-mill.		Ground in an iron mortar.
No.	Temperature of laboratory.	16 to 20 grams, one hour at 135°.	1 gram, one hour at 107°.	16 to 20 grams, one hour at 135°.	1 gram, one hour at 107°.	1 gram, one hour at 107°.
1	88° F	12.07 12.14	11.70	....	....	10.39 11.09
1	76° F	....	....	11.96	11.92	11.43
2	88° F	12.32	....	....	....	11.05
3	77° F	13.61	13.85	13.38	13.67	12.83
3	66° F	13.92	14.06	13.56	13.72	13.24
4	78° F	1.33	1.22	1.33	1.16	1.03

Coal No. 3 gave *in vacuo* over sulphuric acid for twenty-four hours:

	Per cent.
Ground once	14.03
Ground twice	13.88
Ground in mortar	13.62

Coal No. 4 gave on further drying *in vacuo* for twenty-four hours after heating for one hour at 107°:

	Per cent.
Ground once	1.26
Ground twice	1.24
Ground in mortar	1.07

A large amount of additional work on the subject of moisture, with coals of a greater variety, seems desirable. Enough has been done, however, to demonstrate that a close approximation to the truth can be obtained only by the most careful treatment of the samples. Every coal analyst, who has not given careful attention to the question, should convince himself by comparative determinations that the methods which he uses do not cause serious loss of water before the determination is made.

Volatile Combustible Matter.—Place one gram of fresh, undried, powdered coal in a platinum crucible, weighing twenty or thirty grams and having a tightly fitting cover. Heat over the full flame of a Bunsen burner for seven minutes. The crucible should be supported on a platinum triangle with the bottom six to eight cm. above the top of the burner. The flame should be fully twenty cm. high when burning free, and the determination should be made in a place free from draughts. The upper surface of the cover should burn clear but the under surface should remain covered with carbon. To find "Volatile Combustible Matter" subtract the per cent. of moisture from the loss found here.

The method recommended in our first report, and given here without change, has been the occasion of considerable discussion within the committee, and also by others. Very little experimental evidence has been submitted to us, however, and that obtained by Mr. Austin at the Rose Polytechnic Institute appears to be decidedly in favor of the method given (see below).

The method differs from that of Muck[1] in placing the crucible six to eight cm. above the burner instead of three cm. and in continuing the heating for a definite length of time. The flame is much hotter at six to eight cm. above the burner than at three cm., and, if the full flame is used, as directed, the crucible will be sufficiently well covered by it. The time limit corresponds more nearly to present practice in America and is likely to give more concordant results than Muck's direction to stop heating with the disappearance of flame at the edge of the lid of the crucible. The time limit is that proposed by Hinrichs, but the use of a blast is omitted.

In discussing the subject, it should be distinctly understood,

[1] Chemie der Steinkohle, p. 10.

at the outset, that the term "Volatile Combustible Matter" does not represent any definite compound or class of compounds which exist in the coal before heating. Mr. Austin's results demonstrate that some of the carbon which escapes in the form of volatile compounds on rapid heating, is separated in the free state and remains as "Fixed Carbon" when the first heat is applied slowly. It is well known, too, that many of the compounds contained in the gas and tar formed by heating bituminous coals are decomposed by heat with the formation of free carbon. The "Fixed Carbon" retains a considerable amount of hydrogen which is progressively expelled by heating to higher and higher temperatures, until, at temperatures approaching that of the electric arc, it all escapes and the carbon remaining crystallizes in the form of graphite. It follows, therefore, that, no matter what method of heating, or what temperatures are used, the determination must be an arbitrary one.

The two considerations which should have greatest weight in the selection of a method appear to be that the method chosen should, if possible, give results which approximate closely to those obtained in the commercial manufacture of coke from the same coals, and that the method should be one which can be accurately described so that different operators will secure concordant results with samples of the same coal. No experimental evidence on either point has been furnished the committee. Some evidence upon the first point is furnished by Mr. Austin's work below, and the results are certainly favorable to the method which we propose.

The most serious objection which has been raised against the method is the claim that certain non-coking coals suffer mechanical loss from the rapid heating. No evidence as to the extent of such loss has been given. The following determinations of ash in the original coal, and in the coke obtained by the method recommended, prove that in the case of these coals, at least, any mechanical loss which occurred must have been insignificant. Coals 5, 6, 7, and 8 were coking coals; 10 was a non-coking coal from Colorado.

	Ash from coal.	Ash from coke.
5	4.74 4.73	4.75
6	5.43 5.35 5.39	5.43
7	2.32 2.37	2.32
8	13.52	13.52
10	10.62	10.60

Further determinations of this kind with non-coking coals are very desirable, but, even if a small amount of mechanical loss is found to occur in such cases, it does not follow that a different method should be used for them. Since the determination is, in any case, an empirical one, uniformity in the method for all cases is extremely desirable.

One chemist has furnished us with data which show that he has obtained, with the use of a Rose crucible in a muffle, results which agree closely with those obtained by the method proposed by the committee. Further evidence upon this point is very much desired, as the exigencies of many laboratories demand that the determinations should be made in a muffle.

The following determinations of coke by different methods were made by Mr. N. M. Austin. The coals used were:

3. Coking coal, Leith Mine, Pa.
4. Coking coal, Mammoth Mine, Pa.
5. Coking coal, McClure Mine, Lemont, N. Y.
6. Coking coal, Valley Mines, Pa.
7. Lancaster semiblock coal, Owen Co., Indiana.
8. Coking coal used at the Terre Haute Water Works.
9. Coking coal from Hantana, Tennessee.
10. Non-coking coal from Colorado.

Coals 3, 4, 5, and 6 were furnished by Mr. Clingerman of the Frick Coal Co., with the statement that these coals run very evenly for the production of coke, and give a yield of sixty-eight to seventy per cent.

No.	Seven minutes, full flame. Wet coal.	Seven minutes, full flame. Dry coal.	Five minutes, inch high flame. Five minutes, full flame.	Three and a half minutes, full flame. Three and a half minutes, over blast.
3	67.33 67.36	67.03 67.50 67.62 67.96	71.55	66.52
4	68.96 69.02	68.92	73.41	67.92
5	68.55 68.31	67.78	72.88	67.71
6	68.97 68.90	68.99	73.60 72.92	67.41
7	48.82 49.27	50.30 50.46	54.32	46.91
8	53.70 53.65	53.57	59.00	51.58
9	65.68 65.94	65.75	70.30	65.35
10	41.48	41.55 37.40	45.43	39.31

The moisture in these coals is given on p. 1120. The agreement with the commercial coking value for the Pennsylvania coals must be considered as satisfactory. The effect of slow heating in increasing the amount of coke is very evident. The amount of coke, or of fixed carbon, by slow heating was, on the average, 4.58 per cent. higher than by the rapid heating. That this is not due to mechanical loss is proved by the ash determinations above.

In using the blast, the flame of the blast was applied before the flame of the Bunsen burner was removed. The results are, on the average, 1.38 per cent. lower than with the Bunsen alone. It is believed that this is not due entirely to the expulsion of volatile matter, but, in part, to the fact that the flame of the blast is more strongly oxidizing and carbon dioxide and water-vapor enter the crucible from it in larger amount. The fact that the western coals, 7, 8, and 10, with their more porous, and, in the last case, pulverulent coke, show much greater differences than the others, supports this view. The results with the Bunsen alone approach more nearly to the commercial coking values, and it is believed, too, that they are much more likely to give concordant results in the hands of different operators.

Little difference is shown in the average between the results with the original wet coal and with the dry coal. The use of the wet coal is recommended because the drying causes changes in the coal otherwise than by expelling the moisture, and because undried coal is always used in the manufacture of coke. No time is lost by such a procedure, since the ash can be determined much more quickly with the coal used for the moisture determination than with the coke. It took four hours to burn the coke to ash in a platinum crucible, while the dry coal may be burned in a porcelain crucible in two hours or less.

The results of Messrs. Meade and Attix published in this Journal (21, 1137) seem to show very clearly that the heating of coke or anthracite coal in a crucible with the blast, causes a very considerable loss by oxidation. It is probable that heating with the blast in an atmosphere of nitrogen or hydrogen is the most satisfactory method for materials of this class, but further comparisons of the results obtained in that way with the results obtained by the method recommended by the committee are very desirable.

Ash.—Burn the portion of powdered coal used for the determination of moisture, at first over a very low flame, with the crucible open and inclined, till free from carbon. If properly treated, this sample can be burned much more quickly than the dense carbon left from the determination of volatile matter. It is advisable to examine the ash for unburned carbon by moistening it with alcohol.

When the sulphur in the coal is in the form of pyrites, that compound is converted almost entirely into ferric oxide in the determination of ash, and, since three atoms of oxygen replace four atoms of sulphur, the weight of the ash is less than the weight of the mineral matter in the coal by five-eighths of the weight of the sulphur. While the error from this source is sometimes considerable, the committee does not recommend such a correction for "proximate" analyses. When analyses are to be used as a basis for calculating the heating effect of the coal a correction should be made (see below).

5. *Fixed Carbon.*—This is found by subtracting the per cent. of ash from the per cent. of coke as found in paragraph 3. Sulphur, which passes partly into the "Volatile Combustible

Matter" and partly into the coke, is not considered in the calculation.

6. *Sulphur.*—Eschka's method is recommended for general use. The following directions, which are given for the convenience of those using this report, are those of G. L. Heath[1] with slight modifications.

Mix thoroughly, one gram of the finely powdered coal[2] with one gram of magnesium oxide and one-half gram of dry sodium carbonate, in a thin platinum dish having a capacity of 75 to 100 cc. A crucible may be used but a dish is preferred. The magnesium oxide should be light and porous, not a compact, heavy variety.

The dish is heated on a triangle over an alcohol lamp, held in the hand at first. *Gas must not be used*, because of the sulphur it contains. The mixture is frequently stirred with a platinum wire and the heat raised very slowly, especially with soft coals. The flame is kept in motion and barely touching the dish, at first, till strong glowing has ceased, and is then increased gradually till, in fifteen minutes, the bottom of the dish is at a low, red heat. When the carbon is burned, transfer the mass to a beaker and rinse tne dish, using about fifty cc. of water. Add fifteen cc. of saturated bromine water and boil for five minutes. Allow to settle, decant through a filter, boil a second and third time with thirty cc. of water, and wash till the filtrate gives only a slight opalescence with silver nitrate and nitric acid. The volume of the filtrate should be about 200 cc. Add one and a half cc. of concentrated hydrochloric acid, or a corresponding amount of dilute acid (eight cc. of an acid of eight per cent). Boil till the bromine is expelled and add to the hot solution, drop by drop, especially at first, and with constant stirring, ten cc. of a ten per cent. solution of barium chloride. Digest on the water-bath, or over a low flame, with occasional stirring till the precipitate settles clear quickly. Filter and wash, using either a Gooch crucible or a paper filter. The latter may be ignited moist in a platinum crucible, using a low flame till the carbon is burned.

In the case of coals containing much pyrites or calcium

[1] This Journal, 20, 630.

[2] With coals high in moisture a correction may be necessary on account of the loss of water in powdering the coal. (See above under moisture.)

sulphate, the residue of magnesium oxide should be dissolved in hydrochloric acid and the solution tested for sulphuric acid.

If desirable, the burning of the coal with Eschka's mixture may be carried out in a muffle, from twenty to thirty minutes being required.[1]

The following determinations made by Geo. Steiger, under the direction of Dr. Hillebrand, demonstrate the necessity of examining the residue of magnesium oxide and ash for sulphur. In these determinations both ammonium nitrate and bromine water were used.

	Sulphur extracted by water.	Additional sulphur extracted by hydrochloric acid.	Total sulphur.
1	4.447	0.114	4.561
2	0.744	0.057	0.801
3	0.613	0.037	0.650
4	1.888	0.111	1.999
5	2.652	0.067	2.719
6	1.392	0.082	1.472
7	1.879	0.083	1.962
8	0.957	0.041	0.998
9	0.593	0.032	0.625

A mixture of five grams of the sodium carbonate and ten grams of the magnesium oxide should be boiled several times with water, the solution filtered and acidified, the amount of sulphuric acid present, if any, determined, and the appropriate correction applied. The operator should, of course, satisfy himself that the bromine water and hydrochloric acid used are free from sulphur.

The following method of R. W. and A. J. Atkinson deserves consideration from those who find it more convenient to work in a muffle. The method has also been applied to iron ores.[2]

One gram of the finely ground coal or coke is mixed thoroughly with five grams of dry sodium carbonate, spread evenly over the bottom of a flat or shallow platinum dish, and the latter placed on a rectangular rest made of clay-pipe stems inside of a muffle which, though hot, is still black. The temperature of the muffle should be raised gradually during half an hour to clear cherry-redness and then kept at the latter temperature for ten or fifteen minutes. The sodium carbonate should not sinter or fuse.

1 Rothe: Stahl und Eisen, XII, 31 (1894).

2 *J. Soc. Chem. Ind.*, March 29, 1886; J. Iron and Steel Inst., No. 2 (1896).

The mass should not be stirred. When the carbon is burned, usually in about forty-five minutes in all, cool, digest with 100–120 cc. of warm water, allow to settle, decant through a filter and wash twice by decantation and then on the filter, adding a few drops of a solution of pure sodium chloride, if the residue tends to pass through the filter. The filtrate is acidified with twelve cc. of concentrated hydrochloric acid and precipitated with barium chloride as above. No oxidizing agent is required.

R. W. Atkinson has demonstrated that the evaporation with hydrochloric acid to remove silica, which some recommend, is unnecessary. His statement is confirmed by the experience of one of the members of the committee in similar cases.

A few determinations made by this method under the direction of one of the members of the committee have given good results, but no careful examination of the method has been made.

7. *Ultimate Analysis.*—It seems to be unnecessary to give directions for the determination of carbon, hydrogen, and nitrogen here. In determining carbon and hydrogen, lead chromate or some other means for retaining sulphur must, of course, be used. The amount of nitrogen is so small that the use of a copper spiral is not necessary.

The method to be used in calculating the oxygen of the coal presents, perhaps, the question of greatest difficulty. If we could be sure that all of the sulphur is present in the form of pyrites, and that this is converted into ferric oxide in the ash, the oxygen should be found by subtracting from 100, the sum of carbon, hydrogen, nitrogen, ash and *five-eighths* of the sulphur. This is probably the safest rule which can be given for general use, and especially for coals high in sulphur. The operator should, however, satisfy himself as to whether the ash is practically free from sulphates, and, if possible, whether the sulphur is mainly in the form of pyrites. If necessary, the rule should be modified, in particular cases, accordingly.

8. *Heating Effect.*—In the preliminary report the recommendation was made that the heating effect be given on the basis of the coal burned to vapor of water at 100° C. After some criticism from others and further consideration, we have concluded to recommend that results be given for the coal burned

to liquid water at the ordinary temperature. The reasons for this recommendation are that this appears to be the common practice in this country, and because coals are burned to liquid water in the bomb calorimeter, which undoubtedly furnishes the best determinations of heating effect at present available. Engineers and others will, of course, understand that the heating effect, when stated in this manner, includes three and a half to four per cent. of heat which can never be secured under the conditions of practical use.

The most reliable formula for the calculation of the heating effect of a coal burned to liquid water is that of Dulong, which gives the calorific power in calories per kilogram.

$$\text{Calorific power} = 8080\,C + 34{,}460\,(H - \tfrac{1}{8}O) + 2250\,S.$$

For the calculation of the oxygen, see the paragraph on ultimate analysis.

The calorific power in British Thermal Units per pound may be found by multiplying that in calories per kilogram by nine-fifths.

The theoretical evaporative effect is to be calculated by dividing the number of calories per kilogram by 536, or the number of British Thermal Units per pound by 965, and subtracting from the result one-seventh more than the amount of water formed by burning one kilogram of the coal. The addition of one-seventh is given because the liquid water, on the basis of which the heating effect is given, must be considered as changed from water at ordinary temperature to steam at 100° C. The amount to be subtracted may be taken as 0.55 for most bituminous coals. The result gives the theoretical number of kilograms, or pounds, of water converted into steam from, and at, 100° C by one kilogram, or pound, of coal.

The rule given, tentatively, in our preliminary report for the calculation of heating effect, from the amount of combustible matter present in bituminous coals, has been found to be of limited application.

The following averages for the heating effect of the combustible matter of a series of bituminous coals, and for the composition of the combustible matter which they contain, have been calculated from the results obtained by Professor N. W.

Lord and Mr. F. Haas[1] with a bomb calorimeter. The combustible matter for the calculations included carbon, hydrogen, nitrogen, and oxygen. The oxygen was calculated on the supposition that the sulphur was present in the form of pyrites. (See paragraph 7.) The calorimeter result was corrected by subtracting the heating effect of the sulphur. The sulphur averages are given, though it was not included in the combustible matter. The results are for the coals burned to liquid water.

No of samples.	S.	C.	H.	O.	N.	Calories per kilogram by bomb calorimeter.	Calories per kilogram, calculated.
3	1.59	80.63	5.40	12.26	1.71	7860	7847
2	3.01	82.15	5.36	10.97	1.53	8148	8012
9	2.20	83.66	5.51	9.33	1.51	8255	8255
15	2.29	83.97	5.60	8.79	1.66	8372	8335
2	1.28	85.93	5.47	7.06	1.54	8508	8523
3	0.59	91.28	4.52	3.29	0.91	8783	8792

The agreement between the calorimeter results and those calculated by the formula indicates that the latter are sufficiently accurate for most purposes, when calorimeters are not available.

Professor Lord concludes from his work[2] that the heating effect of the combustible matter of coal from the same seam over wide areas, is nearly identical. If the heating effect has been determined for several samples of the coal a factor similar to those in the last two columns above may be calculated and this may be used with a good degree of accuracy for the calculation of the heating effect of other samples from the same seam. For the purpose of such calculations it is recommended that the combustible matter of the coal be calculated by subtracting from 100 the per cents. of ash and moisture and one half of the sulphur. If the sulphur were all in the form of pyrites five-eighths of the sulphur should be subtracted but the rule given is considered sufficiently accurate for the purpose in question.

In a similar manner, if the percentage composition of the combustible matter in a seam of coal has been determined, this

[1] Trans. A. I. M. E., 27, 259.

[2] *Loc. cit.*

may be made the basis for the calculation of a factor which can be applied for the calculation of the heating effect of other samples from the same seam.

WILLIAM A. NOYES,
W. F. HILLEBRAND,
C. B. DUDLEY.

LEMON FLAVORING EXTRACT AND ITS SUBSTITUTES.

BY A. S. MITCHELL.

Received September 18, 1899.

AS many valuable papers have lately appeared upon the subject of vanilla flavoring extract, while little has been done upon lemon extract and its substitutes, I have ventured to here outline the results of the investigation of these goods as found upon the market, and made in the course of work for the Wisconsin Dairy and Food Commission.

Lemon extracts, following the U. S. P. formula for "Spiritus Limonis" should contain at least five per cent. of oil of lemon dissolved in deodorized alcohol and should be colored only with the coloring from lemon peel.

A preliminary examination of the extracts supplied by grocers showed them to contain alcohol in amounts varying from fourteen to ninety-four per cent. by weight and oil of lemon from none to eight per cent.

The extracts low in alcohol had in many cases a fine aroma derived from agitation with new oil of lemon in some cases but more frequently produced by citral and the so-called "soluble oil of lemon" or from lemon-grass or citronella aldehyde and frequently with the addition of tincture of nutmeg, mace, or capsicum. The cheaper grades contained so little oil in solution that the addition of water frequently failed to produce turbidity.

As no standard methods were in use for the examination of lemon flavoring extracts, it was thought desirable to make an examination of the oils used. Optical methods proved most satisfactory for this purpose. The following table gives the behavior of pure oil of lemon and of the various oils and substances entering into the composition of adulterated and sophisticated lemon extracts.

	Rotation in alcohol.			
	Five per cent.	One per cent.	Rotation of oil.	Refraction at 30° C. showing dispersion.
Oil of Lemon (F. B.)	16.4	3.3	64.0	67–71
Oil of Lemon (D. B.)	16.2	3.2	63.2	68–72
Oil of Lemon (S.)	...	..	...	68–72
Oil of Lemon (H.)	16.5	3.3	64.3	67–71
Oil of Limes (E. & A.)	9.2	1.8	36.0	83–87
Limonene (E. & A.)	9.2	1.8	36.0	87–95
"Soluble Oil of Lemon" (F. B.)	1.7	0.3	7.0	82–98
"Citral 80 per cent." com	1.5	0.3	5.9	80–86
Oil of Lemon grass (D. B.)	—1.2	—0.2	—4.7	80–90
Oil of Lemon grass (F. D.)	—1.1	—0.2	—4.3	83–95
Oil of Lemon grass (F. B. double rect.)	—1.6	—0.3	—6.3	82–90
Oil of Citronella (D. B.)	—2.8	—0.6	—10.9	78–83
Citronella aldehyde (F. B.)	1.7	0.3	6.6	36–38
Oil of Turpentine	..	..	..	59–61

The rotation was determined in the Schmidt and Haensch polariscope upon the solution in a 200 mm. tube, direct and using the cane-sugar scale. The figures given in the column headed "rotation of oil" are calculated to circular degrees for comparison with standards.

The refraction is given in degrees of the Zeiss butyrorefractometer, which instrument is to be had in most food laboratories. It will be noticed that many of the oils exhibit wide dispersive powers, which property proves a valuable aid in their detection in the precipitated oil obtained in small quantities from the extracts in the process to be described.

From these figures it will be seen that oil of lemon will produce a dextrorotation of about 3.4° for each per cent. of oil in alcoholic solution under the above conditions.

Soluble oil of lemon or commercial citral can only be used in amounts of 0.33 per cent. or less owing to the pronounced flavor. Upon this basis the largest quantity of these oils that could be used in an extract would produce an effect equivalent to one-tenth per cent oil of lemon (0.1° to 0.2°).

Oils of citronella, lemon-grass and citronella aldehyde are used in much smaller amounts, so that while their tendency is to counteract the optical effects of oil of lemon, their actual effect

is wholly insignificant. All are used in amounts less than one-tenth per cent.

Oil of limes is slightly more expensive than lemon oil and equally insoluble in weak alcohol. There is therefore no incentive to its use. The same may be said of limonene, but if either of these were used they would be indicated by the greater refraction of the recovered oil.

In the absence of sugar, then, the oil of lemon may readily be estimated by polarizing the extract in a 200 mm. tube and dividing the result in degrees by 3.4. A ready check may be made, and a portion of the oil may be had for examination with the refractometer, by the following process.

A flask similar to a Babcock skim-milk bottle is obtained. This bottle should have a capacity of approximately eighty cc. and have two necks. The larger tube (used for filling) should enter at the side and pass almost to the bottom of the flask. The smaller tube (used for measuring the precipitated oil) should have an internal diameter of about three mm. and a length of about fourteen cm. Such a tube will contain one cc. between its extreme graduations. This should be graduated in ten equal parts and each tenth subdivided into fifths. Each of the smallest divisions will indicate two-tenths per cent. when ten cc. of extract are used.

For the purposes of examination ten cc. of the extract are pipetted into the flask above described. About ten drops of concentrated hydrochloric acid are added (sulphuric acid must not be used) together with thirty cc. of warm water. The flask is then placed in water at a temperature of 70° C. with occasional shaking until the oil separates, which will usually take about thirty minutes. The flask is then filled with warm water by means of the side tube and may then be whirled in the centrifuge and the oil brought into the graduated neck. Fair results may be had with the ordinary Babcock bottle but the precipitation is not as complete as when more water is used and the measurement is not sufficiently exact with the small amount of extract taken.

Recovery of the oil by the above process is most complete with extracts containing five per cent. or more of oil. As a rule a six per cent. extract will yield 4.80 per cent. by precipitation, a five per cent extract 3.80 per cent., and a two and a half per

cent extract about 1.20 per cent. The results obtained by precipitation should then be corrected accordingly, after which the results should agree within two-tenths per cent. of those obtained by polarization, unless foreign optically active substances are present.

"Soluble oil of lemon" is recommended by makers to be used in amounts of about 0.33 per cent. only, but if it were used in large amount it would largely be precipitated by this method. Three per cent. may be recovered from a five per cent. solution in stronger alcohol.

The claim is frequently made that limonene, which is undesirable, is all that is excluded when an extract is made with weak alcohol and subsequently clarified with magnesia. This statement is misleading. With the limonene sample obtained from Eimer and Amend three and four-tenths per cent. was recovered from a five per cent. solution by the above method, showing that in weak alcohol (about twelve per cent.) limonene is even more soluble than pure oil of lemon.

In recovering oil from extracts containing less than two and a half per cent. oil and which are always weak in alcohol, twenty cc. of extract may be taken.

A portion of the oil precipitated may then be removed with a two cc. pipette and examined with the refractometer. If pure oil has been used the refraction will be nearly normal as given in the table.

Oil of limes, limonene or citronella oil would be indicated by a higher refraction as would also soluble oil of lemon. Citronella aldehyde and oil of lemon-grass would tend to lower the refraction but neither could be used in an extract in quantities sufficient to greatly alter it.

For the accurate determination of the alcohol, twenty-five cc. are pipetted into a 100 to 110 cc. sugar flask, and about two cc. each of a concentrated solution of aluminum chloride and disodium hydrogen phosphate are added and the flask is filled to 110 cc. with water and well mixed. The mixture is poured upon a dry filter and 100 cc. of the filtrate received for distillation. Twenty-five cc. of water are added to the 100 cc. fraction and the whole distilled to 100 cc. The alcohol is then estimated from the specific gravity of the distillate.

In most cases, however, it is sufficient to prove the absence of sugar, glycerine or solid extract by evaporating ten grams on the water-bath. These substances being absent and the specific gravity of oil of lemon (0.858) and stronger alcohol (0.820) being approximately the same, when an extract does not contain over six per cent. of oil, the alcohol may be approximated within one per cent. directly from the specific gravity of the extract.

Methyl alcohol may be looked for by adding ten cc. of a fresh one per cent. solution of sodium nitroprusside in water to an equal volume of extract and then making the mixture strongly alkaline with ammonia. A red color will appear within a few moments when wood alcohol is present. Oil of lemon does not interfere. Unfortunately this test is valueless for the detection of the more highly purified grades of methyl alcohol, such as "Columbian spirits" and "synthetic alcohol." These can only be detected by the more complicated tests as described in Allen's "Commercial Organic Analysis."

The coloring of lemon extracts is seldom from lemon peel but is generally an aniline. Curcuma is seldom used owing to its liability to fade. Indications of the coloring used are frequently yielded upon the addition of hydrochloric acid during the precipitation of the oil. Sulphonated azo dyes (tropæolins) which are frequently met with react pink or red upon the addition of the acid, and dinitrocresol is indicated by the bleaching of the solution.

The coloring-matters are best obtained by evaporating the alcohol and dyeing skeins of wool with the aqueous solution of the dye. The coloring-matter may then be identified as indicated in Allen's "Commercial Organic Analysis" and in Weyl's "Sanitary Relations of the Coal-tar Colors."

The following table gives the results of examination of a few characteristic extracts.

1. ..... : Alcohol, 21.0 per cent. by weight; rotation 0.2°, oil of lemon less than one-tenth per cent.; coloring-matter, naphthol-yellow.

2. "Special Extract of Lemon:" Alcohol, 20.6 per cent.; rotation 4.6°, cane-sugar 1.31 per cent.; rotation due to oil 0.6°, equivalent to two-tenths per cent. oil of lemon; colored.

3. "Triple Extract of Lemon:" Alcohol, 94.3 per cent.; ro-

tation 23.1°, equal to six and seven-tenths per cent. oil; color, lemon peel only.

4. "Ten Cent Lemon:" Alcohol, 71.7 per cent.; rotation 21.5°, equal to six and three-tenths per cent. oil; precipitation with correction showed five and six-tenths per cent. oil; difference due to presence of cane-sugar; color, tropæolin.

5. "Monarch Lemon Extract:" Alcohol, 94.66 per cent.; rotation 25.7°, equal to seven and a half per cent. oil; precipitation gave seven and three-tenths per cent. oil of lemon, having a refraction of 65°–69°.

6. "Bon-ton Extract of Lemon:" Alcohol, 22.85 per cent.; rotation 0.1° (trace of oil); coloring-matter, dinitrocresol.

7. "Extract of Lemon:" Alcohol, 89.9 per cent.; rotation 20.8°, equal to six and one-tenth per cent. oil; precipitation yielded six and two-tenths per cent. oil of lemon, of refraction 63°–68°.

8. "Double Strength Lemon Extract:" Alcohol, 54.4 per cent.; rotation 1.8°, equal to one-half per cent oil; color, dinitrocresol.

9. "Lemon Extract from druggist:" Alcohol, 92.0 per cent.; rotation 15.9°, equal to four and nine-tenths per cent. oil; precipitation showed five per cent. oil, of refraction 64°–68°.

Only such extracts as fail to precipitate with water occasionally show a slight laevorotation.

ON THE DETERMINATION OF VOLATILE COMBUSTIBLE MATTER IN COKE AND ANTHRACITE COAL.

By Richard K. Meade and James C. Attix.

Received July 28, 1899.

SOME years ago a discussion arose between the consumer and the manufacturer of a coke as to its value. The user objected to the high ash and in support of his claim gave the analysis of his chemist, in which the ash was reported at eighteen per cent. The maker replied that the analysis was worthless as the chemist who made the analysis was probably incompetent, since he had reported nearly three per cent. of volatile combustible matter and that in a seventy-two hour coke the volatile combustible matter could not be nearly so high. The question was referred to a well-known analytical chemist. His analysis, while agreeing with that of the consumer's chemists in the percentage of ash, gave the volatile combustible matter as six-

tenths per cent. The consumer's chemists then checked their work and still found over three per cent. of volatile combustible matter. They used the method of heating a one-gram sample for three and a half minutes over a Bunsen burner and then for the same length of time over a blast-lamp, reporting the loss after deducting the percentage of moisture (found on another sample) as volatile combustible matter. A letter to the referee brought out the fact that he used a ten-gram sample and heated for the same length of time. The only excuse the consumer's chemists could give their employers was, that they used the method published in Blair's standard work on the analysis of furnace materials and products and that this was the method usually published in works on metallurgical analysis.

Of the commonly published methods for the determination of volatile combustible matter in coke and anthracite coal, none reach anywhere near even approximation. The method of Hinrichs[1] which, by the way, he recommends for soft coal and says nothing about coke or anthracite, gives far from true results; nor is the method even comparative. Heating first over a Bunsen burner and then over a blast-lamp drives off volatile matter and traces of moisture and *burns some carbon*. The loss occasioned by the latter in many cases amounts to several times that by the two former occurrences. This burning may be prevented by heating the sample in a non-oxidizing atmosphere, such as nitrogen. The loss after such a heating will represent the volatile products driven off by a high temperature. What these products are it is not our purpose to discuss. Probably even when the sample has been thoroughly dried moisture is among them.

The determination of volatile combustible matter in coke is worth doing well or worth doing not at all. If the determination of volatile combustible matter is used for checking the coking of the coal, it is an important determination of itself, and so long as the determination of the fixed carbon depends upon a knowledge of the volatile combustible matter, it is a necessary one indirectly. For, if the volatile combustible matter is one or two per cent. above what it should be, by just so much will the fixed carbon fall short of the true percentage.

The following investigation, looking toward a more satisfactory

[1] *Chem. News*, 18, 53.

method of determining volatile combustible matter, in coke and anthracite, was undertaken by the writers over two years ago and was the outcome of the incident mentioned in the opening paragraph of this paper. The first step was to heat samples of coke in nitrogen, determine the loss and call such loss "volatile combustible matter" after subtracting the moisture, driven off by one hour's heating at 110° C. The method of procedure consisted in weighing samples of from three to four grams of coke into a small platinum dish, placing this in the crucible of the carbon apparatus described by Dr. Porter W. Shimer in the July number of this Journal[1] and passing a slow current of nitrogen through the apparatus until the air had been driven out. The nitrogen used was prepared by heating together, saturated solutions of potassium nitrite and ammonium chloride. The gas was kept in glass gas-holders, and freed from oxygen by passing through cuprous chloride dissolved in hydrochloric acid. The gas was dried just before use by passing through calcium chloride tubes, placed in front of the crucible. The exit tube from the crucible dipped into strong sulphuric acid, keeping any moisture or air from getting back into the crucible. After passing through the crucible for half an hour the current of nitrogen was slackened, a low flame placed under the crucible, the water-cooling apparatus started and the heat then carefully raised. After heating the coke for a few minutes over the full Bunsen flame, the blast-lamp was made to replace the latter and a high temperature maintained for ten or fifteen minutes. The sample was cooled in the current of nitrogen, removed, and weighed. Below are a few results upon a sample of coke which had been dried for one hour at a temperature of 110° C.

After heating three grams over a blast-lamp for fifteen minutes, the loss was found to be 0.31 per cent. After again heating, an additional loss of 0.0003 gram or 0.01 per cent. occurred.

After heating three grams for ten minutes over a blast-lamp, the loss was 0.0090 gram or 0.30 per cent. After again heating, an increase of 0.0001 gram or 0.003 per cent. occurred.

After heating three grams over a blast-lamp for six minutes, the loss was 0.0095 gram or 0.32 per cent. On again heating, the sample lost 0.0002 or 0.007 per cent.

[1] This Journal, **21**, 557 (1899).

Heating in hydrogen was also tried and gave practically the same result. The losses from four determinations were 0.31, 0.31, 0.29, and 0.30 per cent.

At the time these investigations were undertaken, we supposed the idea of heating in nitrogen was original with us. A letter from Mr. W. H. Blauvelt, of the Semet Solvay Co., of Syracuse, N. Y., however, informed us that the method essentially as worked out by us was used in his laboratory and also in various technical and commercial laboratories in England and in Germany. Hydrogen, answering apparently as well as nitrogen, replaced the latter in most of these laboratories.

Samples of coke and anthracite were carefully standardized by heating in nitrogen and the volatile combustible matter then determined by various methods in common use.

The method commonly published of heating one gram for three and a half minutes over a Bunsen burner and then for the same length of time over a blast-lamp was first investigated. A sample of Pocahontas (West Virginia) coke losing, on heating in nitrogen, 0.61, 0.62, and 0.60 per cent. was used in the experiments.

We noted the following points :

Different operators get widely varying results as these determinations will show.

Operator.	Per cent of volatile combustible matter.	True per cent of volatile combustible matter.
A	3.01	0.61
B	2.51	0.61
C	2.36	0.61
D	2.25	0.61

This variation is due to the size of the crucible, the tightness of the joint between the crucible and its lid, the height at which the crucible is placed above the flame and the size of both the Bunsen burner and blast-lamp flames. A large crucible will give a higher result than a small one because the larger the crucible the more air will be present and consequently the more coke will be burned and the greater the loss will be on ignition. Below are some results on this.

Size of the crucible. cc.	Per cent. volatile combustible matter.
12	1.96
12	1.90
16	2.10
16	2.21
21	2.56
21	2.58
30	3.19
30	3.42

Since the burning takes place only on the surface of the sample, the shape of the crucible would also effect the result. In a narrow crucible the loss due to burning of the carbon would be less than in a wide one. In all of the above experiments crucibles of the usual forms were used. Of course the fit of the lid makes a great difference. Dr. Porter W. Shimer, in order to effect a close joint between the crucible and the lid, uses a thin piece of wet asbestos paper. This lessens considerably the quantity of carbon burned.

Ignition over different burners or blast-lamps gives varying results. A large flame, other things being equal, will burn more carbon than a small one. A few results will show the variation one may expect.

Burner. No.	Blast. No.	Loss on ignition. Per cent.
1	1	2.12
1	1	2.20
2	1	2.31
2	1	2.39
1	2	2.91
1	2	2.80
2	2	3.00
2	2	3.11

The results by this method are not even comparative, because some cokes burn more readily than others. A soft coke burns more readily than a hard one. A sample of Connelsville coke containing 0.65 per cent. of volatile combustible matter as determined by heating in nitrogen, gave 2.31 per cent. by heating in a covered crucible. Another sample of Connelsville coke gave 0.21 per cent. of volatile combustible matter on heating in nitrogen and 2.66 per cent. on heating in the same covered crucible, over the same burner and blast-lamp and under as nearly the

same conditions as it was possible to obtain. In this instance a coke containing only one third as much volatile combustible matter as another gave by this method 0.35 per cent. more.

The fineness to which the sample is reduced and the percentage of ash in the coke also probably affect the result.

As the size of the sample increases, a proportionately smaller loss is incurred by burning; there is a limit, however, to which the size of the sample may be carried, for, as the sample increases, the time required to heat the mass of coke to the proper temperature increases also, and a point is reached when the seven-minute heating fails to drive off all the volatile combustible matter. Below is a table showing the effect of the size of the sample on the result.

No. of the sample.	Loss on heating a dried sample in nitrogen.	Loss on heating dried samples of the weight indicated in a covered crucible, for seven minutes.				
		One gram.	Three grams.	Five grams.	Ten grams.	Fifteen grams.
1. Pocahontas coke	1.24	3.01	2.10	1.61	1.21	0.96
2. New River coke.....	0.32	1.69	0.93	0.69	0.55	0.47
3. Connelsville coke....	0.37	1.49	1.03	0.81	0.52	0.42
4. By-product coke.....	0.54	1.61	1.08	0.87	0.60	0.41
5. Pocahontas coke	0.28	1.52	0.90	0.69	0.40	0.38
6. Piedmont (W. Va.)...	0.31	2.87	2.00	1.31	0.96	0.54
7. Anthracite coal.....	2.85	5.10	4.19	3.01	1.87	1.03

The use of a large sample in some cases apparently reaches the same result as heating in nitrogen, but even here the result is chance. A change of burners or crucible will affect a large sample less than a small one but still quite enough to change the loss considerably. In sample No. 3, Connelsville coke, the use of a large sample in the determination shown in the table gives nearly the same result as is obtained by heating in nitrogen. But on taking a sample from the crucible and reheating in nitrogen an additional loss of 0.17 per cent. or nearly one-half of the total volatile matter was experienced, or in other words of the 0.42 per cent. of volatile combustible matter found by heating a fifteen-gram sample first for three and a half minutes over a Bunsen burner and then for the same length of time over a blast-

lamp, 0.20 per cent. was due to volatile matter expelled and 0.22 per cent. to carbon burned.

The Committee on Coal Analysis of the American Chemical Society recommend heating the sample of coal over a Bunsen burner for seven minutes. For soft coals this heating may be sufficient but for anthracite or coke the blast must be used in order to drive off all the volatile combustible matter. The committee, of course, did not recommend their method for coke analysis, or at least failed to say so, in their preliminary report.

A sample of coke containing 0.61 per cent of volatile combustible matter was heated for seven minutes over a Bunsen burner then cooled and weighed. The loss was 0.78 per cent. On heating in nitrogen an additional loss of 0.48 per cent. was experienced. The heating over a Bunsen burner in this case was only sufficient to drive off 0.13 per cent. of volatile matter.

A sample of anthracite containing 2.85 per cent. of volatile combustible matter was heated for seven minutes over a Bunsen burner and then cooled and weighed. The loss was 2.26 per cent. On heating in nitrogen an additional loss of 1.02 per cent. was experienced. The heating over a Bunsen burner in this case drove off 1.83 per cent. of volatile combustible matter.

It is regretted that the larger portion of the work involved by this investigation had been completed before the preliminary report of the Committee on Coal Analysis was published; consequently the authors were not able to apply this method upon as many samples as they would have liked.

If after heating a sample of coke or anthracite over a blast-lamp and burner for say seven minutes and weighing we again heat over the same burners and for the same length of time, the second heating will give us an approximation of the amount of carbon burned in the first. If the loss, therefore, from the second heating is deducted from that of the first the difference will agree fairly closely with the loss obtained by heating in nitrogen or hydrogen. The results, theoretically, should fall a little below the results obtained by the latter method since the volatile matter which is present in the first heating only, displaces some of the air and consequently there will be more oxygen present in the crucible during the first heating than during the second, and more carbon will be burned. To offset this, there will be

slightly less carbon in the crucible upon the second heating, and the coke will be protected somewhat by a slight film of ash formed by the burning during the first. When the sample is small this does not seem to introduce any considerable error and the results are as apt to be higher as they are to be lower than those obtained by heating in nitrogen. Care must be taken to have the conditions of the second heating similar to those of the first. The same burner and blast-lamp must be used; the position of the crucible in the flame and the size of the flames themselves must be the same for each heating.

The timing of the heats must be done with the second hand of the watch or clock and the flames must be protected from air currents and draughts. To show how closely these blanks agree and the range of accuracy of the methods some results follow.

	Three gram samples heated for three and one half minutes over a burner and then for three and a half minutes over a blast give per cent. loss.			
Sample. No.	1st. Heat.	2nd. Heat.	3rd. Heat.	4th. Heat.
1	2.01	0.86	0.84	0.88
2	0.93	0.65	0.61	0.62
3	0.94	0.51	0.56	0.50
5	0.90	0.62	0.67	0.66
6	1.03	0.67	0.66	0.72
7	3.47	0.85	0.89	0.83

By subtracting the second loss from the first we have the results in the first column below.

Sample. No.	By subtracting the second loss from the first.	By heating in nitrogen, per cent. loss.
1	1.15	1.24
2	0.28	0.32
3	0.43	0.37
5	0.28	0.28
6	0.36	0.31
7	2.62	2.85

This is the only simple method we have tried which gives results that approach anywhere near those obtained by heating in nitrogen and hydrogen. The use of asbestos paper to make a close joint between the crucible and its lid is to be recommended where this method is used. The writers have tried placing a weighed sample of coke in a crucible and covering this with a weighed amount of freshly ignited sand. While the blank

from burning does not run quite so high, it does not seem to be any more constant and the results do not seem to justify the extra weighing. It is possible that in a coke laboratory analyzing a fairly even product, a constant blank might be found and deduced, saving the extra heating and weighing.

The writers wish to acknowledge the valuable suggestions of Dr. P. W. Shimer, of Lafayette College, Easton, Pa., and to thank for their kindness Mr. W. H. Blauvelt, of the Semet Solvay Co., of Syracuse, N. Y. and Mr. G. H. Caperton, of the Fire Creek Coal and Coke Co., West Virginia.

REVIEW.

SOME RECORDS OF PROGRESS IN APPLIED CHEMISTRY.[1]

The year just passed has been remarkable for the extension which the industry has undergone rather than for the development of new processes or products. Everywhere demand for products has grown and production has responded to meet it. In the United States this is particularly marked, and it is illustrated in the statistics of the imports and exports of raw materials used in the chemical arts, and of the finished product. Materials needed in the industry in this country, but not produced, or capable of production here, have been brought here in increased quantities, while the finished products have been exported in much the same ratio. We may select for illustration a few products representing the larger industries, and therefore, most widely affecting the general welfare, quoting aggregate values of the various imports.

	1897.	1898.	1899.
Alizarine products	$1,022,970	$ 886,332	$ 700,485
Coal-tar colors and dyes	3,196,478	3,689,214	3,799,353
Glycerine	1,182,099	774,709	1,024,131
Calcium chloride	1,375,560	1,422,920	1,159,271
Potassium chlorate	458,095	308,458	173,488
Caustic soda	1,147,763	476,032	252,291
Sal soda	82,695	40,266	20,905
Soda-ash	1,241,321	589,714	310,742

If on the other hand we consider the products exported, we find a like favorable state of affairs:

[1] Read before the New York Section, October 6, and November 10, 1899.

	1897.	1898.	1899.
Acids	$ 102,483	$ 115,050	$ 207,247
Copper sulphate	.....	415,717	1,173,186
Dyes and dye-stuffs	450,009	442,967	478,582
Calcium acetate	.....	537,586	700,000
Medicines	2,287,744	2,460,669	2,661,008
Fertilizers	5,005,929	4,359,834	6,964,305
Glucose	2,736,674	2,871,839	3,624,890
Glue	132,581	209,441	222,072
Gunpowder and explosives	118,001	139,644	182,142
Glass	1,208,187	1,211,084	1,503,651
Ink, printers' and other	162,995	203,927	210,973
Leather	9,920,851	11,251,851	13,444,569
Naval stores, rosin, tar, etc	9,214,958	9,155,144	9,982,955
Oil cake	9,611,044	12,581,534	14,531,142
Animal oils	643,924	502,332	704,127
Cottonseed oil	6,897,361	10,137,619	12,077,519
Paints	944,536	1,079,518	1,447,425
Paraffin and paraffin wax	4,957,096	6,030,292	6,804,684
Tallow	2,782,595	3,141,653	4,367,356
Lard	20,126,485	39,710,672	42,208,462
Lard compounds	857,708	1,118,659	1,200,231
Oleo oil and oleomargarine	7,214,917	8,290,710	9,693,362
Soap	1,136,880	1,390,603	1,457,610
Wood alcohol	140,046	199,230	414,875
Starch	1,665,926	1,371,549	2,292,973
Sugar and molasses	1,708,962	2,111,658	2,953,888
Blacking	384,937	733,658	852,187
Candles	216,565	232,214	275,470
Cement	71,160	86,208	131,161
Coal	11,008,643	11,683,749	13,661,028
Coke	547,046	608,784	632,788

The figures of the third column are for the fiscal year ending June 30, 1899, and all are taken from the late report of the Bureau of Statistics of the U. S. Treasury Department. It would seem that no stronger or more fitting illustration of the rapid advances the chemical industries are making in the United States could be needed. And it is fair to say that what is true for the United States is true for *most* of the more highly civilized countries. The depression of the past few years has been followed by a reaction, and the increased prosperity cannot fail to bring material advances in both processes and products.

During the year important expositions illustrating the advances in the chemical industries have occurred, and among the more important the Electrochemical Exposition held in Darmstadt on the occasion of the General Meeting of the Vereins Deutscher Chemiker, and the Acetylene congresses, and expositions held in Budapest and Frankfurt. In the former, the electrolytic purification of metals was represented in Elmore and Mannesmann tubes in nickel, aluminum, zinc, tin, gold, and silver; Merck's lithium, mercury, and silicon; chemicals in ammonium and sodium persulphate, pyridine and piperidine, the products of

decomposition of alkaline chlorides, carborundum, calcium carbide; and of the highest interest though not strictly belonging to the electrical products were Goldschmidt's rarer metals produced in the works at Essen. This collection included chromium copper, chromium manganese, and copper manganese, ferro-boron, ferro-titanium, and corundum showing small rubies.

In the acetylene expositions the manufacture of carbide, the apparatus for the generation and utilization of acetylene, and processes for its purification, were shown or illustrated, and the work accomplished must be of value to the advancement of the industry. In addition to the expositions a congress was held for the discussion of the questions relating to the industry.

Dr. Borchers, of Aachen, in an address before the Deutschen Elektrochemischen Gesellschaft, presented interesting statistics showing the status of the electrochemical industry in the world, and condensed the data of his detailed table in the following:

	Power existing or projected.			
	Water power. H. P.	Steam power. H. P.	Gas power. H. P.	Value of the possible annual production.
Africa—Transvaal	....	454	....	$ 7,224,000
America—Canada	1,500	....	....	112,500
" United States	72,300	11,750	2,500	97,506,440
Europe—Belgium	....	1,000	....	148,700
Germany	13,800	16,173	....	13,786,550
England	11,500	8,150	20	2,270,900
France	110,140	1,300	....	11,277,835
Italy	29,485	....	....	2,418,750
Norway	31,500	....	....	1,837,500
Austria	27,000	23	....	2,741,962
Russia	29,000	....	....	2,202,500
Switzerland	38,950	....	....	3,153,162
Spain	7,100	....	....	687,270

In the United States the quantities and values of the several products resulting from the industrial applications of electricity are as follow:

Product.	Quantity.	Value.
Aluminum	11,000,000 lbs.	$ 2,625,000
Gold	154,000 oz.	4,900,000
Copper	150,000 tons.	56,250,000
Silver	49,280,000 oz.	28,350,000
Potassium chlorate	330 tons	54,037
Caustic soda	5,120 "	195,840
Chloride of lime (bleaching-powder)	11,200 "	230,000
Calcium carbide	60,000 "	4,500,000
Carborundum	560 "	140,000
Nickel	182.5 "	114,062

Borchers estimates from the results obtained in various locali-

the gold adheres better, is more easily removed, and the solution is kept cleaner. The gold is not contaminated with lead and need not be cupelled.

Tomasi has further developed his process for desilverization of lead by electrolysis. A rectangular cell enclosing fixed anodes is used and between these anodes of crude argentiferous lead is found the cathode consisting of a disk of aluminum bronze which may rotate at the rate of one to two turns per minute. Only a portion of the disk is immersed in the electrolyte which consists of lead and potassium acetate. The finely divided lead is removed from the cathodes by brushes and collected. The silver falls as anode mud. The physical condition of the lead obtained is most favorable for oxidation.

In the extraction of copper the Herreshoff progressive and continuous roasting furnace has attracted the most favorable attention. It consists of a vertical cylinder divided into sections by horizontal diaphragms, the alternate diaphragms having openings at the center and periphery, respectively, the ore being moved forward and downward by properly arranged rakes the arms of which are attached to a vertical shaft passing through the middle of the cylinder. James and Nicholls, of Swansea, carefully roast the properly concentrated ore and transfer it to a second roasting furnace where it is mixed with a given quantity of fresh unroasted concentrate whereby the copper oxide of the first operation is reduced in accordance with the following :

$$2Cu_2O + Cu_2S = 6Cu + SO_2$$

or

$$2CuO + Cu_2S = 4Cu + SO_2.$$

They claim saving of time, labor, furnaces, loss of noble metals: a high yield of copper, very pure sulphurous gas. Keller considers the purity of the copper obtained not greater than that from the reverberatory furnace process and below that of the Bessemer process.

The Hoepfner process for extraction of copper seems to be extending notwithstanding the unfavorable criticism. It is stated that new works at Papenburg will extract daily about 1000 kilograms of copper. The ore is finely pulverized in a Krupp mill, leached with copper chloride solution, the copper, lead, nickel, and silver extracted, while the cupric salt is reduced to the cuprous condition. The solution is purified, freed from silver, and caused to flow through compartments having carbon anodes and copper cathodes. The chlorine separating at the anode is taken up by the copper solution and the regenerated cupric liquor is heated and returned to a new lot of ore. From Rio Tinto ores with 3.37 per cent. of copper, ninety-one per cent. of the metal was recovered after four hours' treatment and only three per cent. of the iron content dissolved, while by a longer extraction

period 98.5 per cent. of the copper is secured and only four per cent. of the iron taken up. It is claimed for this chloride process that with eight-tenths of a volt ninety per cent. of the current is utilized so that one horse power in twenty-four hours will produce fifty-four kilograms of copper against fifteen kilograms by the sulphate process. Hoepfner claims that by this process the electrolytic recovery of lead, nickel, silver, and zinc has been solved, and discusses the modifications in the process involved.

In the extraction of nickel the process of Mond has been further developed by the construction of extensive works at Southwick in England. The product from the Bessemer process is used. It is first roasted and then contains thirty-five per cent. of nickel and forty-two per cent. of copper, and about two per cent. of iron. The nickel content is then increased to fifty-one per cent. by extraction of part of the copper with vitriol, the residue then transferred to the vertical plate furnace, and the copper and nickel reduced with water-gas hydrogen at a temperature not above 300° C. without reducing the iron. The nickel is now volatilized below 100° C. as the carbonyl compound in the plate tower. After a time the residue is returned to the reducing tower, and thus wanders back and forth between both ovens seven to fifteen days when sixty per cent. of the nickel will have been removed. The carbonyl compound is decomposed at 180° C. and the nickel deposited on iron plates or in a granular condition, while the carbon monoxide is returned to the furnace. The metal obtained contains 99.8 per cent. nickel and it is claimed that the process may compete with others for the extraction of the metal.

Storer's method seems to have the attraction of being inexpensive and simple. He treats ores containing silicate, hydrate, or oxide of nickel with ferrous chloride solution,—one part of ore with 2.75 parts of solution containing 26.5 parts of the iron salt,—in a closed vessel heated to 187° C. with live steam and with corresponding pressure. After five to eight hours' digestion, and double decomposition has been effected, the vessel is emptied, the iron oxide produced is collected, and washed to be used as pigment, while the nickel may be separated from the solution by electrolysis or by precipitation. About 750 pounds of ferrous chloride are consumed per ton of ore.

The metallurgy of zinc has been practically stationary. Jones subjects the ore to oxidizing and roasting, leaches the ore with water or weak acid, separates the iron with ammonia, filters and electrolyzes in a cell with a diaphragm, adding ammonium sulphate to the anode space. Kohler heats the roasted and oxidized ore with ammonium sulphate, leaches the residue, and precipitates the solution to recover the zinc as hydrate. Bechi mixes the ore with "Abraumsalz" or common salt and roasts the mixture.

Then he leaches the residue, heats the solution with zinc hydrate, whereby copper is precipitated and zinc chloride left behind. This latter may be decomposed by lime, or the zinc may be separated by electrolysis. Schultz finds that zinc chloride ordinarily electrolyzes with difficulty and that presence of water is unfavorable. He evaporates the solution almost to dryness and mixes with strong hydrochloric acid, when, it is declared, electrolysis becomes easy and the deposit fine.

The process of Goldschmidt for obtaining high temperatures and the reduction of refractory metallic oxides by combustion of aluminum has been further developed. The aluminum used must be finely divided and intimately mixed with the oxide to be reduced. The mixture is ignited by adding a strongly oxidizing agent such as barium dioxide and after being started may be made continuous. The alumina slag solidifies as corundum and may be used as abrasive material or for the manufacture of aluminum. The method is employed for production of alloys and for welding. For the latter purpose an impure aluminum serves perfectly well. Kupfelwieser has made a careful study of the method of Goldschmidt. He finds the heat of combustion of aluminum to be 7140 calories and gives the following data representing the requirements for production of one kilogram of:

	Iron.	Manganese.		Silicon.	Chromium.	Tungsten.
Compound used	Fe_2O_3	MnO_2	Mn_2O_3	SiO_2	Cr_2O_3	WO_3
Aluminum required	0.484	0.656	0.492	1.272	0.520	0.294
Heat developed, calories	3456	4684	3512	9082	3712	2099
Heat consumed:						
(*a*) for reduction	1796	2115	2000	7830	2200	1100
(*b*) for melting slag	548	742	550	1439	582	324
(*c*) for melting metals	362	535	535	435	434	360
Total heat used	2706	3392	3091	9704	3216	1784
Excess to cover losses, etc.	750	1292	421	672	497	315

Silicon has been produced in the electric furnace. Hyde has thus produced the crystalline and graphitoidal form, and so likewise has De Chalmot. The latter obtains a mixture of copper, silicon, and copper silicide. The copper is separated with nitric acid and the liberated silicon freed from silica with hydrofluoric acid. The Fabrik Elektrometallurgischer Produkte zu Frankfurt-Bockenheim, have, by a secret process, brought into the market rods of silicon which they specially recommend for use in manufacture of iron and steel. In iron it increases the graphite, reduces the shrinkage of castings and the tendency of liquid iron to absorb gases. For low carbon steel it is desirable because it effects the necessary reductions without introducing carbon. The same firm offer copper silicide in eight to nine kilogram bars, containing ten, fifteen, and thirty to thirty-five per cent. of

silicon. This compound serves for deoxidation of copper instead of copper phosphide. Silicon increases the strength but reduces the conductivity of copper containing it. These relations are as follows:

	Strength per square millimeter. Kilograms.	Conductivity.
Pure copper	28–35	100
Copper with 0.5 per cent. silicon	50	28
Copper with 3.5 per cent. silicon	95	7

But the compound is useful in the form of bearing metal, strong wire, and sheet, for resisting acid gases and vapors.

The production of phosphorus in the electric furnace has been extended, and this is not the only application of the current to high temperature distillations. Several forms of furnace have been devised for heating materials with exclusion of air and with reducing media, together with condensation and collection of the volatilized products. Many attempts, more or less successful, have been made both in this country and abroad to apply them to the production of phosphorus. In most cases the calcium phosphate is heated with excess of carbon, liberating the phosphorus and leaving calcium carbide behind. In other cases, as in the furnaces of Albright and Wilson, the phosphate is mixed with sand as well as carbon. Harding makes a tolerably pure phosphoric acid, and this, mixed with carbon, is charged to an electric furnace with an outlet at one side for slag. A hollow electrode projecting through the bottom is connected with a carefully controlled supply of volatile hydrocarbon, such as gasoline, and the phosphorus liberated and volatilized is carried off through a pipe at the top of the furnace. Hasenclever discussing the progress in sulphuric acid manufacture in 1898 calls attention to the improvements made by the Badische Anilin und Soda Fabrik in the application of the contact reaction of Winkler, whereby combination of sulphur dioxide and oxygen is effected by passing the gases over platinized asbestos or pumice. They found that the heat generated by the reaction tends to so heat the after-end of the contact mass as to cause it to induce a reverse reaction and the reduction of the sulphur trioxide to the dioxide. To prevent this they cool the contact mass either by currents of air or gases about it, or by baths of fused metal, and the cooling is so carefully controlled that the reaction is practically quantitative. Besides the very much larger yield obtained, injury to the apparatus, and weakening of the contact mass are diminished.

Another important requirement of the successful application of this reaction is that the gases shall be free from dust and injurious impurities such as arsenic, phosphorus, mercury, etc. If washed with water, the gas must subsequently be dried, and it must be chemically and optically free from dust.

Meyer proposes the use of cylindrical instead of rectangular chambers in the manufacture of sulphuric acid, and recommends spiral circulation of the gases. In the application of the idea the gases from the Glover tower are made to enter tangentially at the periphery of a vertical cylindrical chamber and at about midway between the top and bottom. Circulating about they pass out at the center of the bottom and pass along to other chambers which may be similarly cylindrical or of the rectangular form. The outlet, to provide against destruction of lead connections which had been found to occur, is of stoneware of special construction, and to increase the cooling surface a cylinder is let into the center of the top of the chamber, and circulation of air induced by an open pipe hanging within the cylinder. The air flows down through the annular space thus made and up through the pipe. Numerous economies are claimed for the system.

Hydrogen sulphide is formed in considerable quantity as a by-product in asphalt refining in the works of the California Asphaltum Works at Ventura, California. It is burned to sulphur dioxide, and this in turn is converted in chambers in the usual way to vitriol yielding daily ten tons of finished acid of very high purity.

Mourlot produces magnesium sulphide in the electric furnace by heating together, in molecular proportions, magnesium chloride and tin sulphide, with a current of 50 volts and 2000 amperes. Tin chloride is formed and volatilized while magnesium sulphide remains, partly or wholly fused. The latter product is not attacked by the carbon of the anode, is less sensitive to the action of water than the powdery form which decomposes suddenly under such influence, but in the presence of steam, it breaks up quickly with formation of magnesium oxide and hydrogen sulphide.

It is well known that when an acid sodium sulphite is treated with zinc, three molecules enter the reaction and sodium hydrosulphite and double sulphite of sodium and zinc are formed.

$$3HNaSO_2 + Zn = NaHSO_2 + Na_2Zn(SO_2)_2 + H_2O.$$

But Prudhomme finds that if ammonium bisulphite solution be neutralized with ammonia, and the whole poured over zinc, the reaction, as written by him, becomes:

$$2(NH_4)_2SO_3 + Zn = (NH_4)_2SO_2 + Zn(NH_3)_2SO_3 + H_2O.$$

The zinc salt is insoluble and may be separated by filtration. The advantages of this reaction are: direct formation of a neutral salt less easily oxidized than the acid salt with ninety-six to ninety-eight per cent. of the theoretical yield; utilization of half the bisulphite treated; production of neutral hydrosulphite free from zinc salt by simple filtration.

Grossmann's process is still more economical as regards consumption of bisulphite. Taking a solution of the salt of 60° Tw. and containing twenty per cent. of total sulphur dioxide, he mixes it with sulphuric acid and zinc dust in accordance with the following reaction:

$$3NaHSO_3 + 3Zn + 3H_2SO_4 = 3NaHSO_2 + 3ZnSO_4 + 3H_2O.$$

He found that the liquor so produced has three times as much reducing power as the ordinary zinc bisulphite bath in indigo-dyeing and considers it a distinct improvement upon the bath heretofore used.

The electrolytic production of chlorine and its compounds has undergone considerable increase during the past year. Hasenclever says the extension of electrolytic chlorate manufacture both in Sweden and French Switzerland has been so active that the price has fallen in Germany from 100 to 120 marks per 100 kilograms to about 55 marks, and that many manufacturers have resorted to manufacture of other products particularly carbide.

Production of chloride of lime has grown to such an extent that increasing quantities are available for export. John Brock, president of the United Alkali Company, stated to the stockholders that while in 1895 the export of soda from England to America was 125,698 tons, it had fallen to 29,393 tons in 1898. During the same period caustic fell from 33,625 to 11,171 tons, and chloride of lime suffered in the same way. The company had established works at Bay City, Michigan, to supply the American market under the title, The North American Chemical Company.

The National Electrolytic Company, of Niagara Falls, now use 1100 horse power supplied by the Niagara Falls Hydraulic Power Company in the production of potassium chlorate, using the process of W. T. Gibbs applied to potassium chloride from Stassfurt. They are now doubling their works.

The cell and diaphragm of Hargreaves and Bird have at last been authentically described. The cell is made up of two parts, the anode compartment and the cathode space. The former consists of a leaden box, pitched inside and further lined with a wall of Portland cement. Bolted to each side of this is a cast-iron box which encloses the cathode space. If the cell be horizontal, only one cathode space is provided and constitutes the bottom. The anodes consist of rectangular carbon slabs which are arranged parallel with each other, the edge of one overlapping that of the other, forming a sort of horizontal grating in the horizontal cell and sustaining walls in the vertical ones. The anodes project through the one wall and rest in depressions in the other, the outer ends being covered with lead or type metal connected with each other by metallic conductors. Between the

anode and cathode spaces is the cathode diaphragm peculiar to the Hargreaves cell. It consists of iron gauze upon which has first been floated paper or asbestos pulp. This is covered with Portland cement in moist thin layer, and for protection this in turn is covered with porous fibrous material such as asbestos cloth, wool, or other similar substances. For easier removal of the product the layer next the gauze is impregnated with some soluble substance which, in the first operations, washes out, leaving narrow spaces about the wires of the cathode.

When the cell is set up the anode space is filled with the electrolyte solution, and solid electrolyte (salt) is fed in through an opening in the top which is closed, when the cell is in operation, by a stoneware lid resting in a water seal. In the horizontal cell the solid electrolyte rests upon the anodes and in the vertical cell is held between the two rows of anodes. Inlets and outlets are provided for the circulating electrolyte solution, and for exit of chlorine. If the solid electrolyte contains too much insoluble impurity it is dissolved in a separate vessel through which the liquid electrolyte is made to circulate. Steam is fed to the cathode space and the caustic dissolved flows out through the bottom.

One of the criticisms of the Hargreaves cell has been that the alkali produced is contaminated with salt. This difficulty has been overcome by the application of the fact observed by Hargreaves that when salt solution containing but little sodium carbonate is evaporated, the carbonate content increases and the mother-liquor contains salt and carbonate in the molecular ratio of 2 : 1 ; and furthermore that on boiling salt crystals or a crystal mixture of salt and carbonate (the monohydrate) with a large quantity of concentrated soda solution, the salt will be dissolved and separated from the monohydrate. Hargreaves has devised a system of pans and crystallizing vessels for effecting such separation.

The method of circulation of the cathode mercury of the Castner-Kellner cell has been the subject of modification at the hands of several inventors with more or less advantage. G. and G. W. Bell having in view both this and the saving of cell space, erect three columns of shallow trays, the trays of the middle column being much larger than those of the other two columns. Communication is established between the trays of the middle column and those of the same level of the outer columns respectively in such a way that when the cells are charged with mercury a perfect seal between them is established. Inlets and outlets for circulation of electrolyte in the outer series of cells is provided, and each anode cell has likewise an outlet for chlorine communicating with a general conduit. The cells are firmly held together by bolts passing vertically through all. The anodes

project horizontally through the anode cell walls, each tray being provided with the necessary anodes. Water is fed to the trays of the middle column and may be caused to circulate. With the apparatus properly set up, charged with mercury and electrolyte and the current operating, the chlorine outlet of one series of anode cells is partly closed and pressure thus generated within the cells drives the mercury toward the other columns. After a proper time this outlet is opened, the pressure released, the outlet of the other column partly closed, and the current of mercury reversed. The mercury is thus made to oscillate back and forth between the anode cell and the so-called cathode cell, but really the decomposition cell, and the reaction completed.

The Electron Chemical Works effect a circulation of the mercury by means of a steam injector, whereby the mercury is atomized or pulverized in contact with steam. The latter is decomposed by the alkali metal, an excess being condensed to dissolve the hydroxide produced. The mercury is led back to the electrolytic cell by gravity and the circulation thus maintained.

To obviate the difficulty arising from the diffusion of the anode and cathode products in apparatus having a mercury cathode, the Solvay Company resort to superposed strata of electrolyte of different densities and maintain these densities by careful circulation of the liquid of the strata through boxes containing the solid electrolyte. Vertical diaphragms across the ends of the cells and extending to different depths serve to establish the layers and the circulation of the strata of liquid is maintained by pumps.

Acker decomposes fused salt over melted lead, producing chlorine and sodium lead alloy. The furnace consists of two concentric cylinders of magnesite. The inner cylinder really constitutes a bell hanging within the outer cylinder. The bottom of the furnace is of iron, and the cathode passes through it. Fused lead is fed through the bottom until the mouth of the bell is sealed and the current is applied while the anodes within the anode space is in contact with the lead. These are withdrawn until an arc is produced, and salt is instantly charged to the annular space. Chlorine is generated and is led away through an outlet provided for it, and the sodium liberated combines with the lead. The alloy, which is lighter than the metal rises within the bell and overflows through a tube passing out at the bottom. No data regarding the operation and efficiency of the furnace are given.

Muspratt and Smith find that the requirements of successful operation in manufacture of high strength hypochlorite solution, are: Continued excess of alkali in solution, low temperature, below 80° F., a gravity of solution at which salt deposits most readily, prompt and complete removal of scum if present, and periodical introduction of caustic. The stability of the product

depends upon the absence of iron and the maintenance of such strength that salt does not deposit. The authors declare that under favorable conditions, solutions containing thirty-five per cent. by volume of available chlorine may be made, and such a solution is, excepting unmerchantable strengths of hydrogen peroxide, the strongest oxidizing agent known.

It has been found that electrolytic chlorine does not give a good yield of chloride of lime, and Sindig–Larsen ascribes this to the fact that electrolytic chlorine is more active than that produced by chemical methods and believes that the oxygen is replaced producing calcium chloride. To avoid this he carefully dries the gas by passing it over calcium chloride, and then heats it by passing it through tubes heated to 700° or 800° C. Then it is cooled and passed into the lime chambers in the usual way.

Dr. Erich Muller finds that the efficiency of electrolysis in the production of oxidized salts of chlorine, bromine, or iodine, is greatly enhanced by the addition of a small proportion of potassium dichromate. Thus with a thirty per cent. salt solution he obtained 32.8 per cent. current efficiency, while with a similar solution under practically like conditions, but containing 0.18 per cent. of potassium dichromate, he secured 69.6 per cent. of current efficiency. The current efficiency in the production of iodate was ninety-seven per cent. while 97.6 per cent. of bromide was converted to bromate corresponding with ninety-four per cent. efficiency.

Meister, Lucius, and Bruning oxidize chromous salts by electrolysis in presence of sulphuric acid with a current of three and five-tenths volts, and 300 amperes and a temperature of 50° C. The operation is carried out in a leaden vessel with a diaphragm. When the anode liquid is fully oxidized it is removed and the cathode liquid transferred to the anode cell and the cathode cell filled with fresh solution. To obtain the best results a solution of high conductivity is recommended and the proportion of 100 grams of chromic oxide, and 350 grams of sulphuric acid seem to meet this condition.

The Neustassfurt Salt Works oxidize manganate to permanganate by electrolysis in a vessel in which the cathode cells filled with water are suspended in the anode liquid in which the manganate is dissolved. Upon application of the current the manganate is oxidized and potassium hydroxide is liberated in the cathode cell. When the strength of the hydroxide reaches forty per cent. the permanganate is nearly insoluble, and precipitates. To maintain the proportion of manganate this salt is suspended in the anode liquid in vessels with perforated bottoms. The process may be made continuous.

To prepare oxygen, Stewart fuses a mixture of sodium

manganate and hydroxide, the proportions of the constituents being such that fusion occurs at 375° to 400° C. The fusion is effected in cast-iron vessels and air is passed through the mass. When, after a few minutes, absorption of oxygen is complete, air is cut off and steam admitted. Oxygen is promptly evolved and decomposition is soon complete. The operation is then reversed. Four retorts, two feet square and eight feet long, are said to have a capacity of 140 to 150 cubic feet of oxygen daily. Hitchcock declares that when oxygen is used with bleaching-powder the efficiency of the latter is increased, and a saving of thirty to forty per cent. is effected.

Ladenburg condenses ozone by cooling it with liquid air and fractional distillation of the ozonized oxygen. Oxygen passes off until the volume is reduced to ten per cent. when evaporation ceases. The product thus obtained has a dark blue color, contains 86.14 per cent. of ozone and has a density of 1.3698 compared with oxygen. From this the density of ozone was found to be 1.456. The liquid ozone boils at —125° C. but at once explodes violently.

The commercial production and utilization of ozone is extending. Kershaw discusses the more recently improved forms of apparatus for the purpose and particularly those of Andreoli, Otto, Yarnold, and Siemens and Halske, describes their construction and operation and presents data of yield obtained and cost of energy employed to produce one kilogram of ozone and active oxygen respectively as follow:

Form of ozonizer.	Yield of ozone per E. H. P. hour Grams.	Cost of electrical energy per kilo of ozone.	Cost of electrical energy per kilo of active oxygen.
Yarnold	175	$0.57	$0.513
Otto	150	0.20	0.60
Andreoli	94	0.30	0.954
Siemens and Halske	20	1.50	4.50

According to Kershaw ozone produced by the apparatus of Yarnold, Otto, and Andreoli is three to four times as expensive as bleaching-powder and about fifty per cent. more expensive than sodium bichromate, as a source of active oxygen. Engledue places the cost of ozone produced by the Yarnold apparatus at about five and one-fourth cents per pound, of active oxygen at about fifteen, and of one electrical horse power at two cents. The successful production of ozone requires absence of heating in the apparatus and that the air to be ozonized shall be thoroughly dry and free from dust. Engledue proposes many uses of ozone including bleaching of oils and in this latter is supported by Ronco who declares that in the practical operation, the cost of handling, daily, five tons of oil effectively, was 45 francs. Andreoli recommends purification of water with ozone and states

that after treating water containing from 6,000 to as high as 110,000 microorganisms per cubic centimeter, in eleven trials, no active organisms remained; in ten other trials ten organisms per cubic centimeter were found, and the largest number found after four other trials was forty.

The production of liquid air is progressing and it is fair to believe that it will find practical applications. A company has been established in New York City for the manufacture of liquid air and claim a daily capacity of 1,500 gallons. Facts regarding cost of the product are not easily obtainable but there is reason to believe that it can be produced at low expense.

Hempel declares that with Linde's machine, one horse power hour will yield one cubic meter of air containing fifty per cent. of oxygen. He states that though its chemical uses thus far have been confined to making an explosive by mixing with carbon, and to producing chlorine in the Deacon process, it should also serve a useful purpose in making producer gas whereby, in the product, the carbon monoxide, marsh-gas, and hydrogen would be increased about 100 per cent. and the nitrogen reduced to a corresponding extent. It should also be used for increasing the efficiency of combustion of ordinary fuels, in the operation of gas engines, in connection with the Bessemer process and in the manufacture of sulphuric anhydride by the contact process. He would furthermore use the nitrogen in a concentrated state for the production of nitrides and cyanides.

In the past couple of years the production of white lead has received marked attention and many new and promising processes of manufacture have resulted. Beilly, Cox, and Hey volatilize the metal in an electric furnace, subject the vapor to the action of air and steam, carbon dioxide, and acetic acid. The resulting reaction occurring is said to yield white lead of high quality. Cook and Clark on the other hand subject finely divided lead to the action of water and air and claim production of the hydroxide. This is separated by levigation from the unoxidized metal and the process continued until the metal is all oxidized. The hydrate is used as such or is carbonated with gas to produce white lead. In the Mathews process the ground oxidized product is digested a short time with a solution of lead oxide in glycerine and acetic acid and the solution filtered. The filtered liquid is then treated with pure carbon dioxide to proper saturation, the fine white precipitate of basic lead carbonate separated and washed in a filter press. The mother-liquor and washings are returned to the beginning of the operation. The cake from the filter-press is carefully dried and is in such condition that mill-grinding is not needed. The solution contains seven to seven and a half per cent. of glycerine and this seems essential to the proper precipitation of the

product. It is claimed for the process that white lead can be produced by it at greatly reduced cost and that its color and general physical properties are superior to those of the product obtained by the corrosion process.

Galloway's process depends upon the decomposition of lead nitrate with ammonium carbonate under pressure.

The Elektrochemische Industrie Gesellschaft (Köln) have improved upon the process of Luckow. In the new process the anion of one salt serves to dissolve the anode and the anion of the other salt precipitates the dissolved metal. The first salt is present in the proportion corresponding with the highest conductivity of its solution, while the second which serves to precipitate the metal in the insoluble condition is calculated from the electrochemical equivalent related to the current strength. It is by this rule found that seven per cent. of sodium chlorate and 0.011 per cent. of sodium carbonate are the proportions of these substances in solution best suited to the electrolytic production of white lead using hard lead anodes and soft lead cathodes; ten anodes and eleven cathodes, each with a surface of twenty by thirty cm., are suspended in the solution, fifteen cm. apart. During the electrolysis, with a current of five-tenths ampere per square decimeter and one and two-tenths to one and three-tenths volt at a temperature of 15° to 17° C., carbon dioxide is carefully injected into the solution through fine jets for the regeneration of the precipitation salt and circulation of the liquid.

Bradley and Jacobs have developed an interesting reaction in the electric furnace. They find that if barium sulphate be heated with a limited supply of carbon, part of the sulphate is reduced to sulphide and the sulphide reacting upon the residual sulphate converts it into oxide with the production of sulphur dioxide. The oxidation of the sulphide is not complete and the product in actual practice contains about forty per cent. of sulphide.

To avoid glazing the surface of barium carbonate when heating it to prepare barium dioxide, Feld encases the furnace with iron and uses fuel producing no vapor of water in burning, thus excluding all moisture from the furnace. Knoop renders phosphorite and other similar phosphatic material citrate-soluble by heating it with silica and alkali salts, and after an extended experience finds a mixture of chalk sand and alkali sulphate with the phosphate to give the best results and to make ninety-nine per cent. of the phosphate soluble.

Mabery and Baltzley recommend the use of sodium aluminate for removal of lime and magnesia from water and claim to have removed from water ninety-eight per cent. of these substances

even when the quantity of reagent used was less than was required by theory. Their paper on the subject is to be found in the pages of this Journal.

The extension of manufacture of coke with recovery of gas and by-products is increasing both in Europe and this country. In the latter they have been established at Halifax, Nova Scotia, Boston, Mass., Glassport, Penna., Benwood, West Virginia, and Ensley, Alabama. The operation of these furnaces has been discussed by Pennock in our own Journal and by Hoffmann in the *Engineering and Mining Journal*. The latter authority states that in Halifax, where the Semet-Solvay ovens are built in groups of ten, each retort is charged with five tons of coal which is coked in twenty hours. The gas-pressure is 1.25 cm. and the temperature of the oven 1000° to 1100° C. The coal used contains about sixty per cent. of fixed carbon and the gas produced having over sixteen candle power is used for lighting and the remainder for heating. Thirty-seven tons of coal coked in twenty-four hours yields 31,000 cubic feet of gas, of which 32.26 per cent. is illuminating gas and 67.74 is power-gas. The coal contains nine and nine-tenths per cent. of water of which four per cent. is hygroscopic. The results obtained at Glassport, using Youghiogheny coal, are of interest.

Products from one long ton of coal.		Pounds.	Per cent.
Coke { Large coke > one inch	66.69	1593.4	71.13
Coke { Small coke a half to one inch	1.64		
Coke { Breeze < one inch	2.80		
Tar		75.7	3.38
Ammonia (=1.373 sulphate)		7.6	0.34
Gas, total 10,390 cu. ft. of 0.466 sp. gr.		368.0	16.43
Sulphur compounds in gas.			
Hydrogen sulphide, 0.98 lb. per 1000 cu. ft.		10.8	0.48
Carbon disulphide, 0.13 " " " " "		1.6	0.07
Gas liquor and loss by difference		182.9	8.17
		2240.0	100.00

49.5 per cent. of the gas was surplus, not needed for heating the ovens. The coke contains 8.91 per cent. of ash, 1.27 per cent. volatile matter, 0.0041 per cent. phosphorus, and 3.67 per cent. water. The tar recovered is preferable to gas-tar for distillation.

Muller shows that benzene is appreciably soluble in water and that this should be taken into account when large volumes of water are used in the scrubber for purification of the gas. Absorption varied with the proportion of benzene and from about three to eight per cent. of that present. Paraffin oil absorbs practically all the benzene and is used in the determination of that present in coke-oven gas.

According to Scheithauer, if 100 cubic meters of gas from oil be compressed to twelve atmospheres, six to eight kilograms of liquid hydrocarbons are separated and the gas loses twenty-five per cent. of its illuminating power. The condensed liquid contains seventy per cent. of benzene, fifteen per cent. of toluene, five per cent. of higher homologues, and ten per cent. of ethylene homologues.

The production and utilization of calcium carbide have made some advances and many of the difficulties involved have been obviated. The subject has been discussed so clearly and with such manifestly high authority by Wolff in an address before the Berlin Section of the Vereins Deutscher Chemiker that it seems important to present here a somewhat detailed abstract of what he has set forth.

He gives Moissan the credit of being the original producer of carbide in a large way declaring that Bullier and Willson followed and made their discoveries practically simultaneously, but with no knowledge of each other's work. The industry had extended so that in the autumn of 1897 the power consumed thereby in Germany was 6,000 to 8,000 horse power, in Norway 19,000, while works are projected in the Tyrol and other localities in Austria, in Switzerland, France, and Sweden. He states that in 1897 the production amounted to 10,000 tons. Yet in spite of the wide extension of the production he expects little reduction in the price of the product. The cost depends upon three factors: 1, cost of power; 2, price of raw materials; and 3, yield. All these naturally vary greatly. Mode of operation, plans of furnaces, construction, etc., likewise influence the results. Saving of heat is one of the most important and the author commends Pictet's plan of previously heating the charge by means of gas and the oxyhydrogen flame, thus saving the current. He finds the cost of carbide at the works at Vernier, near Geneva, to be 157 francs, say, $31.40 per ton (1000 kilograms).

Discussing the danger from explosion of acetylene, he ascribes it to two causes: 1, carelessness; 2, the chemical and physical properties of acetylene. The first cause is avoidable by bearing in mind that ordinary gas and air mixtures have explosive limits of between eight and twenty-eight per cent. while acetylene air mixtures which contain three to eighty-two per cent. of acetylene are explosive. Under ordinary pressure acetylene is not explosive. Under high pressures and liquefied it may be. His conclusion is that acetylene is no more explosive than any other burning gas; but it may be and is dangerous under false conditions and in bad apparatus.

His experience with producers leads him to recommend unqualifiedly the apparatus of Pictet in which the carbide is

allowed to fall into a large volume of water and for purification he recommends the method of Frank, subjecting the gas to the cleansing action of acid metallic salts. Yet because of the many inconveniences due to ammonia and sulphides in the gas he prefers his own; that is, washing the gas in calcium chloride solution to remove ammonia and sulphides, and then passing it over chloride of lime to oxidize the phosphorus and other compounds.

For burners he particularly recommends two of special construction based upon the Bunsen principle. The first consists of two tubes pointing toward each other at right angles, the jet from one impinging upon that from the other. The gas issues from a small aperture in a tube surrounded by four air-holes, so that the gas issues from the tip mixed with air. The other consists of a small metal tube with a slit burner of lava like ordinary gas-burners. The gas issues from a small aperture surrounded by air-holes and mixed with air issues from the slit burner. These forms prevent overheating and consequent decomposition of the gas before burning and avoids deposition of heavy decomposition products in the slit. The cost of the gas to consumers must naturally vary. Compared with illuminating gas at say $1.20 per thousand cubic feet and acetylene at $10.50 for the same quantity, the ratios for sixteen candle power of light become:

Acetylene	$1.65
Gas, slit burner	3.00
Gas, Welsbach	0.54
Electric incandescent lamp	3.50

With gas at sixty-five cents per thousand, the price paid in New York at the present time, the figures for light with that substance would become 1.50 and 0.27. Under any circumstances therefore acetylene could not compete with gas in Welsbach burners but it would be less expensive than electric light.

Lewes recommends the use of acetylene in admixture with water-gas and Julius Pintsch mixes thirty-five volumes of acetylene and sixty-five volumes of oil-gas for use as illuminating material. This mixture may be compressed to six atmospheres without danger of explosion.

Pictet's method of purification of acetylene consists in passing the gas through a calcium chloride solution cooled to —20° C. and then through concentrated sulphuric acid cooled to —40° C. It gives excellent results. A. Frank uses a mixture of one part copper chloride and eight parts hydrochloric acid. Acid-resisting vessels are naturally necessary. Wolff recommends chloride of lime (bleaching-powder) mixed with chromic acid salts. Ullman recommends chromic acid alone and finds that it removes both phosphorus and sulphur. He considers it the most effective purifying agent thus far used.

Berthelot and Vielle find that when acetylene is mixed with other gases, such as hydrogen and illuminating gas, the pressure limit for explosibility approaches that for acetylene alone, and particularly as the content of acetylene grows. The law is independent of the inert gas. Emerson Reynolds made experiments on the influence of carbon dioxide on the illuminating power of acetylene. Five to eight per cent. of carbon dioxide reduces the smokiness of the flame and especially prevents clogging the burners. Increase in illuminating power was not marked, but the mixture containing five per cent. of carbon dioxide gave as much light as acetylene alone and there was, therefore, reduction of the volume of acetylene burned. Carbon dioxide probably has some oxidizing effect.

To undertake a discussion of the forms of furnace for manufacture of carbide would be impossible within the limits of this paper. The principal improvements depend upon continuity of operation, saving of heat generated in the operation by applying it to increasing the temperature of the charge or heating the charge from external sources in order to reduce the consumption of heat of the arc.

Bradley and Horry obtain more or less of continuity of operation by causing the charge to meet the electrodes in the periphery of a wheel or cylinder, so that the carbide formed in blocks at one side may be removed more or less cooled at the other side. The production of dust seems to be one of the prime difficulties occurring in the operation of this furnace.

Kenevel, Spofford, and Mead use horizontal revolving cylinders as electrodes in the bottom of a vertical shaft and so aim at continuity. Roberts feeds the charge from a hopper upon the electrodes, arranged horizontally above a movable apron or endless belt. The electrodes are brought into contact covered by the charge, the belt set in motion, the electrodes gradually separated, and the motion of the belt graduated to the speed of formation of carbide between the electrodes. The carbide lies in a bed of material of the charge and is covered with it. It, therefore, has an opportunity to cool with partial exclusion of air. Pictet heats the charge in a vertical shaft on its way down to the electrodes, nearly to the temperature of the reaction, thus saving electrical energy. His furnace is being used by the Ingleton Carbide Company in England. Memmo charges a mixture of calcium hydroxide and carbon and uses the water-gas said to be formed in the furnace for heating the charge. But these problems presented in the carbide manufacture are not easy and they still await perfect solution.

Hintz and Bunte, independently of each other, have made experiments with Welsbach mantles to determine the best mixture to use in their manufacture, to secure the highest efficiency

find that the mixture of pure thorium oxide with pure cerium oxide is best, and that the presence of other oxides such as neodymium, zirconium, lanthanum, and yttrium are rather detrimental than otherwise. They find that the efficiency of the mantles declines with the length of use, and that the consumption of gas per Hefner candle power, under the different conditions stated, is as follows :

Thorium oxide. Per cent.	Cerium oxide. Per cent.	Gas consumed during burning. 100 hours. Liters.	400 hours. Liters.	800 hours. Liters.
99.9	0.1	12	15	15
99.5	0.5	3.3	4.3	5.2
99.0	1.0	2.6	3.0	3.6
99.0	1.0	2.9	3.2	5.2

Other experiments gave :

Mixture. Thorium oxide. Per cent.	Cerium oxide. Per cent.	Hourly consumption for one Hefner candle power.
99	1	1.7
98	2	2.2
97	3	2.4
96	4	4.2
90	10	13.0
80	20	27–34
70	30	31–85
50	50	87–110

Bunte found that pure thorium oxide gives little light (three H. C. P.), pure cerium oxide but little more (six to seven H. C. P.), while the Welsbach mixture gives about seventy H. C. P. He explains this by the theory of Drossbach, according to whom pure thorium does not react upon light waves except in presence of a small quantity of cerium, when it becomes resonant and illuminating.

Auer von Welsbach uses a filament of osmium *in vacuo* heated by the electric current, finding that it will withstand a higher temperature than carbon. It is therefore more efficient, since incandescence increases rapidly with the temperature. When heated to volatilization of platinum it gives a most agreeable white light. The osmium may contain platinum in small quantity but it must otherwise be pure. He greatly increases the luminosity by covering the osmium filament with thorium oxide.

Nernst has further developed his incandescent lamp, the value of which depends upon the power of magnesia when heated to conduct the current, to become further highly heated by the current, and in consequence of the intense heating to become incandescent. He constructs a thin cylinder of magnesia, heats it to the temperature necessary to conduction and passes the current. The light developed amounts to one Hefner unit (0.88 English unit) per watt, against one Hefner unit to three or four watts,

with the ordinary incandescent lamp. Nernst finds that even at 1000° C. magnesia does not conduct well and that its conductivity may be increased by addition of boric acid, calcium chloride, and tungstic acid. Zirconium oxide with about five per cent. of yttrium oxide; thorium oxide with twenty per cent. of yttrium oxide; thorium oxide with thirty-seven per cent. of zirconium oxide, three per cent. yttrium oxide, and three-tenths per cent. cerium oxide, likewise increase the conductivity.

The report of the Allgemeine Elektricitäts Gesellschaft to the stockholders states that the efficiency of the light seems to be about that of a small arc-lamp; that for convenience of handling it is superior to the arc-light but inferior to the incandescent lamp. Deri mixes the earthy oxides with difficultly fusible metal or graphite, both in the form of exceedingly fine powder. The tubes or filament made with the mixture are enclosed in vacuum bulbs or are surrounded with indifferent gas. The heat developed in the conducting material is communicated to the earthy oxide, causing it to glow and become conducting.

The production of nitrogen compounds, ammonia, and cyanides, which acquired such marked impetus a few years ago, seems to have fallen into the ordinarily recognized channels, and ammonia from coal and cyanides from animal refuse still control the markets. The extension of the by-product coke ovens has increased the ammonia production and will continue to do so, and we may expect that the immediate future will offer considerably enlarged supplies. The president of the Society of Chemical Industry offers the following statistics regarding the recovery of tar and ammonia in Great Britain:

	Tar. Tons.	Ammonium sulphate. Tons.
Gas works	650,000	130,000
Shale Oil Works	.....	37,000
Blast-furnaces	150,000	18,000
Recovery ovens	62,000	11,000
	862,000	196,000
Possible production after extension of recovery ovens	620,000	110,000
	1,482,000	296,000

The by-product ovens are being everywhere extended. As already stated, the number of such ovens is rapidly increasing in this country, and we may expect that the tar and ammonia production resulting therefrom will have an important influence upon the market in these commodities. In Germany, likewise, where these ovens first secured really permanent foothold, the by-products have become important factors in the nitrogen supply market.

The utilization of atmospheric nitrogen is still attractive to investigators and inventors. The fixation of free nitrogen by the soil bacteria is now fully established, and the means for stimulating this important supply of available nitrogen have become the subject of most profound study and with gratifying results.

The fixation of atmospheric nitrogen by artificial, chemical, and mechanical means has likewise been the subject of encouraging study. Lord Rayleigh's results in the removal of nitrogen from the air by its oxidation through the influence of the spark or of the silent electric discharge, has directed study to the conditions and reactions involved and the possibilities of profitable fixation of nitrogen by such means. Shenstone and Evans find that under strong electric tension atmospheric oxygen suffers contraction and ozone is formed. Eighty to eighty-three per cent. of the oxygen may be so transformed, and under certain conditions ninety-eight per cent. But if the tension acts too long, nitrogen dioxide will be formed, the ozone will suddenly be destroyed, and the oxide decomposed. Vapor of water favors the formation of nitrogen oxide which, as Rayleigh found, must quickly be removed from the electric influence to avoid decomposition.

Crookes[1] discusses his suggestion that the nitrogen supply for agricultural purposes must be obtained by artificial means from the atmosphere, and bases some calculations regarding the possibilities upon the experiments of Rayleigh in oxidizing nitrogen to obtain a residue of argon, in which, with a consumption of one horse power he obtained chemical combination of 29.4 per cent. of a nitrogen-oxygen mixture. Hence one kilowatt hour would be required for seventy-four grams of sodium nitrate and 14,000 kilowatt hours for a ton (2204 lbs.). With steam power of the highest efficiency, the cost of which is placed at 0.67 cent per kilowatt hour, the cost is stated to be $130. With water power costing 0.15 cent per kilowatt hour the cost would become $25. Electrolytic niter should therefore compete with the natural product, but it is questioned whether the cheap power necessary to the production of the annually required 12,000,000 tons is available.

Moissan finds that nitrogen combines with calcium at dark red heat with incandescence. At 1200° C. the product obtained is crystallized, and its composition corresponds with N_2Ca_3. In presence of alcohol this breaks up with formation of ammonia and calcium ethylate and with cold water it yields ammonia and calcium hydroxide.

[1] Crookes says: Nitrogen is a combustible gas, and the reason why, when once ignited, the flame does not continue to spread through the atmosphere and deluge the world in a sea of nitric acid, is that the igniting-point is higher than the temperature of its flame, not high enough, therefore, to set fire to the adjacent mixture. But by passing a strong induction current between terminals the air takes fire and continues to burn with powerful flame, producing nitric and nitrous acids.

Wolfram introduces calcium carbide into a bath of fused alkali hydrate. Carbon monoxide and hydrogen are liberated, the alkali metal is set free, issues in the form of vapor, and may be collected. If nitrogen or ammonia be passed through the fused mass cyanide will be formed.

Lance and Bourgrade and Emmanuel cause a mixture of nitrogen, hydrogen, and ammonia to act upon carbon heated from 1000° to 1100° C., whereby ammonium acetylide $(NH_4)_2C_2$, is formed, and this in turn combines with nitrogen to form cyanide. Ninety per cent. of the ammonia used is converted.

Vidal proposes generation of cyanide by heating phospham to 150°–200° C. and allowing formic acid to flow into it. Hydrocyanic acid is said to be formed and volatilized to be collected in alkali. And Vittenet heats neutral copper acetate and ammonia of 21° B. in closed tubes two hours at 180°–185° C. White opaque scales of copper cyanide are formed.

Conroy discusses Raschen's process for production of cyanides as practiced at Widnes, near Liverpool. The process consists in treatment of sulphocyanate with nitric acid, whereby sulphur is oxidized with production of sodium sulphate, hydrocyanic acid, and nitric oxide. The volatile and gaseous products are carried along, with vapor of water, into a tower filled with stones, where the water and part of the hydrocyanic acid condenses. The greater part of the hydrocyanic acid passes over and is condensed in water while the nitric oxide is subsequently converted into nitric acid.

A most important step forward in the production of ammonia has been developed by Mond, who found that nearly 100 pounds of ammonia could be recovered per ton of fuel from producer gases by introducing along with the superheated air required to burn the fuel in the producer, two and a half tons of steam for every ton of fuel consumed. The Solvay Process Company, at Syracuse, has erected a plant of eight Mond producers at their works, replacing the use of coal in the steam plant and elsewhere. The production of fuel gas with the recovery of ammonia is said to yield a return of twenty-five per cent. profit on the capital invested.

Waisbain, working under direction of Prof. A. Lidow, undertook dry distillation of wood by passing hot deoxidized gases through the material in the retort, obtaining in a small way much better results than are obtained by the old methods. He used generator gases, controlling their temperature, and found that at 150° C. the wood is not decomposed and only hygroscopic water is removed. Between 150° and 180° C. oxygen compounds, acids, and alcohol are produced. Between 280° and 350° gaseous hydrocarbons are formed, and finally, between 350°

and 430°, tarry products are carried over. In a small way the following results were obtained :

	Birch. Per cent.	Fir. Per cent.
Hygroscopic water	15.0	6.00
Pyroligneous acid (21.8 per cent. acetic)	10.9	6.45
Methyl alcohol	1.2	1.4
Charcoal	31.0	31.0

In a large way, because of defective condensation, less favorable results were secured, but the yield of charcoal of good quality for metallurgical purposes was 95.5 per cent. of the theoretical.

Bach applies practically the same system in a vertical furnace consisting of three parts. In the upper part he applies superheated steam, removing hygroscopic water, and in case of pine, turpentine. In the middle part the dried wood meets an ascending current of oxygen-free gases and vapors. A lower part, corresponding with the crucible of a blast-furnace, serves for partial combustion of the resulting charcoal to furnish carbon monoxide, thus providing the deoxidized gases to be used above and the heat necessary to the distillation. In the upper part of the furnace, which is of metal, the temperature is maintained at from 150°–300° C., and methyl alcohol and some acetic acid is formed. In the lower portion of the furnace, which is of masonry, more acetic acid and tarry products are formed. The products from each portion of the furnace may be withdrawn separately.

The very striking discovery of Buchner, that extract expressed from beer yeast has the power to convert sugar directly to alcohol, has been extensively discussed and the action has been ascribed to various causes, notably the existence of living germs in the extract and the presence of living protoplasm. The possibility of spores has, however, been removed by careful filtration of the extract, and Buchner has shown that living protoplasm is not possible, first by the action of poisons, and second, by first drying the yeast and making an extract with water, which is still active. Geret and Hahn find that the extract acts likewise upon albuminoids. The action is due to an enzyme, which may be precipitated by alcohol and separated from the solution with its activity unimpaired.

Sanguinati has made a study of the application of the molds to the fermentation industries and particularly of *Aspergillus orizae* of Koji, of *Mucor alternans* (Gayon) and *Amylomyces* (Roux) from Chinese beer yeast. All these have energetic saccharifying action. *Aspergillus orizae* first, then *Amylomyces*, and finally *Mucor alternans*. In distillery practice, however, *Amylomyces* is most useful, and because of its slightly

oxidizing action, is alone effective for use in the industry. This is the form used by Collette in Lille and in other French and Belgian distilleries. He proceeds as follows: He liquefies the starch without saccharification by heating the mass with addition of a small quantity of either acid, or malt, or pure culture of the mould or the diastase therefrom, or by pulverizing the starch paste mechanically. He then boils the mass in closed vessels to complete liquefaction and sterilization, then cools and aerates with pure air and inoculates with the mould spores. Saccharification and fermentation occurs and when the operation is complete the liquid is filtered from the residues. It is claimed that an increased yield of alcohol having a fine aroma and taste has been obtained.

Emmerling made experiments to determine whether, and in what proportion, formation of glycerine and succinic acid accompanies alcoholic fermentation of sugar solutions by mold spores. To start the fermentation he used *Mucor racemosus*, easily obtained pure from horse dung. In the fermented product he found both glycerine and succinic acid, the glycerine equivalent to eight and three-tenths per cent. and succinic acid to one and four-tenths per cent. of the alcohol. The fermentation with mold spores is therefore analogous to that of yeast spores.

Simonson has concluded his interesting experiments in manufacture of alcohol from wood sawdust. The process finally adopted consisted in conversion of the carbohydrates by boiling with acid, the ratio of liquid to sawdust being at least four to one and the acid content one-half per cent. The latter was neutralized before fermentation, which was effected at 25° C., and the best result was obtained with bottom yeast. The highest yield of alcohol reached seven and seven-tenths per cent. of the air-dried wood, containing twenty per cent. of moisture and corresponded generally with sixty per cent. of that required by theory for the total sugars present in the fermented liquids. The alcohol obtained was of excellent quality.

Goldschmidt makes sodium formate by heating sodium carbonate in a current of carbon monoxide under pressure. Then he heats together four parts of the crystallized sodium formate so obtained with five parts of anhydrous sodium carbonate in glass or iron vessels with exclusion of air to 400°–410° C., obtaining a mixture of sodium oxalate and formate. This obviates the losses incurred in heating the formate alone.

Zacher proposes manufacture of oxalic acid by first drying wood sawdust *in vacuo* to 100°–150° C. to remove twenty per cent. of the moisture ordinarily present. When dry, he slowly draws in upon the mass caustic potash solution containing six to seven per cent. of carbonate, the solution becoming heated to

122° C. Then the temperature is carefully increased while the mass is being stirred until 180° C. is reached. This is maintained three hours, when the bright-yellow mass is transferred to a hot plate provided with a stirring gear. Here the temperature is brought to 320° C. and so maintained four hours. The melt is a bright gray powder which makes an almost colorless solution. It contains no unchanged cellulose, contains about thirty-two per cent. of oxalic acid, and its solution yields with lime a nearly white precipitate of calcium oxalate. The best dry sawdust is preferable and the advantageous ratio of the sawdust to the caustic is one to two.

Eitner finds that in the extraction of tannin the yield suffers severely at temperatures above 100° C. Proctor and Parker found decomposition even at 100°. Eitner gives in the following table the most favorable temperatures for extraction of the different products:

Oak bark.....	80°–90°	Myrabolum	90°–100°
Mimosa bark.....	70°–80°	Sumac	50°–60°
Fir bark.....	90°–100°	Quebracho.....	80°–90°
Valonia	60°–70°	Divi-divi.....	50°–60°
Trillo-valonia	50°–60°	Canaigre.....	40°–50°

Whether for the industry or for analysis, he recommends that extraction be effected at lower temperatures, 40°–50° C.

The retting of flax has always been a troublesome problem and the process employed from time immemorial almost has been the subject of much thought and investigation. At last a more rapid and effective process seems to have been developed by Doumer and Swarte in France. It has been the subject of a favorable report by a commission appointed by the Ministry of Agriculture in France to investigate it. The flax is subjected in closed vessels, at carefully regulated temperatures, to the action of a liquid fertilized with *Amylobacter microbes*. When the action is complete the flax is drained, washed, and, without being disturbed, dried by a current of hot air. The product is reported to be superior to that obtained by retting in the open air.

The development of the cellulose products of Cross and Bevan is being pushed vigorously, particularly in England and Germany, under the names viscose and viscoid. The former is obtained by combining alkali-cellulose with carbon disulphide, forming the sulphocarbonate and making a ten per cent. solution thereof with water. Viscose so obtained may be stored and transported in vessels of wood or zinc. Iron or copper vessels are attacked by it. It may be preserved in open vessels by keeping it covered with a layer of water, but it must not be subjected to temperatures above 20° C. At 10° it will keep two weeks. It changes, by decomposition, into an elastic mass of

hydrocellulose but passes through stages of gelatinous or half-solid forms. For the various uses its water content and the limits of age and decomposition must be carefully determined.

All its applications depend upon the recovery of the cellulose by its spontaneous decomposition. This is hastened when the product is spread in a thin layer, and it is caused partially by the liberation of carbon disulphide, although part of the change is much more profound. The decomposition may be governed by regulation of the temperature. A film produced on glass, heated to 100° C., becomes entirely insoluble in water.

Viscose, allowed to decompose in large blocks, forms a transparent mass insoluble in water and known as *viscoid*. To insure a perfectly homogeneous product, decomposition must proceed without intervention of heat.

It has been usefully applied to the sizing of paper and tissues adding greatly to their strength. To this end the viscose, after application, must be decomposed promptly, and in the works this is effected by means of sulphur dioxide or metallic salts. The latter form insoluble sulphocarbonates, and that of zinc has been found the most effective. Goods sized with it become water-proof, and if the sizing be sufficiently thick, the finished product has the appearance of leather. It makes fine photographic films, and when spun has the appearance of silk. A wide field of usefulness is predicted for it.

The new product of the laboratories of Cross and Bevan bids fair to find many useful applications. It is cellulose tetracetate and is formed by the reaction taking place between cellulose, magnesium acetate, and acetyl chloride, as indicated in the following formula:

$$C_6H_{10}O_5 + Mg(C_2H_3O_2)_2 + 2CH_3CO.Cl = C_6H_6O_5(C_2H_3O_2)_4 + MgCl_2 + 2H_2O.$$

In manufacturing, this reaction can be carried out quantitatively. By a similar reaction the butyrate may be formed. These products are difficultly inflammable and behave with solvents like the nitrate, giving solutions of a colloidal nature. Their solubility differs from that of the nitrate. The acetate is completely insoluble in methyl alcohol, ethyl alcohol, amyl acetate, acetone, and ether, but soluble in ethyl benzoate, chloroform, epichlorhydrin, aceticanhydride, glacial acetic acid, and nitrobenzene. The solution of the tetracetate in nitrobenzene hardens, on cooling, into a solid but completely transparent jelly. The solution in chloroform, epichlorhydrin, or ethyl benzoate may be diluted to any degree with acetone without causing precipitation. Spread upon glass plates, it gives beautifully transparent films, which are continuous if their thickness is within that of iridescent films.

The tetracetate is indifferent to chemical reagents and as resistant to all acids, except nitric, as the nitrate. Aqueous alkalies, which even in the cold break up the nitrate, do not attack the tetracetate even at high temperatures. Alcoholic soda solution saponifies but does not disintegrate very thin sheets or destroy their transparency. Its insulating power is as great as that of gutta percha or rubber, and it withstands temperatures up to 150° C. In its resistance to chemical agents and its electric properties, the butyrate is similar to the acetate, but it is more soluble than the acetate and dissolves in ethyl acetate and acetone.

Weber, from whose interesting paper the facts quoted are taken, declares that these products will take the place of the nitrate in many respects, and they are particularly valuable because of their resistance to chemical agents, heat and electricity, and their non-inflammability. They are recommended for metal lac.

Fraenkel and Friedlaender find that when cotton yarn is mercerized with alcoholic alkali the strength of the product is greater than when aqueous alkali is used. Mercerization occurs only after immersion and removal from the bath. They found that yarn having a strength of 358 grams supported 553 grams after mercerization with aqueous lye of 35° B., and 618 grams when treated with cold alcoholic alkali and 720 grams with warm alcoholic lye.

Effort, directed to the production of artificial silk, continues in spite of the discouragement offered by the very low prices of the natural product. The cellulose products have thus far been the most promising and Chardonnet's process is carried on commercially. In this process cellulose is nitrated until it appears bright blue in polarized light, carefully washed and dissolved in the alcohol-ether mixture. After filtration it is spun through fine apertures, dried in chambers heated to 45° C., denitrated by alkaline sulphides, bleached, and finally, if desired, dyed with basic colors. Pauly, of Basle, dissolves carefully cleansed cotton in ammoniacal copper oxide solution, and passes the solution through fine apertures to rollers revolving in acetic acid. The fiber is washed and dried in warm air.

Stern dissolves cellulose in strong alkali and carbon disulphide, makes up to ten per cent. solution with water and forces the viscous solution through fine jets into ammonium chloride solution. It is wound on reels from this solution, washed with hot sodium carbonate solution, bleached, washed thoroughly, and dried under tension in air or a heated chamber.

Millar subjects filaments of gelatine to vapor of formaldehyde. The product is insoluble in water, takes color well, but has neither the strength nor the brilliancy of the natural product.

These are some of the advances the year has brought forth. The prevailing demand for material of every description in the arts is encouraging and must stimulate further progress, and we may reasonably believe that the near future will be fruitful in new discoveries. WM. MCMURTRIE.

NOTES.

Chemical Detection of Vegetable Fibers.[1]—This process rests on the property which cellulose possesses of transforming itself under the action of sulphuric acid into carbohydrates, possessing an aldehydic function, which can easily be detected by the colored reaction it gives with the phenols.

The sample to be examined—suppose it to be a piece of woolen goods in which the cotton is to be detected—is, after careful washing, treated by sulphuric acid at 20° B. and heated one-half hour over the water-bath. The imperfect solution is then diluted and the carbohydrates looked for in the following way: In a test-tube about one centigram of a phenol—say resorcine—is introduced, one or two cc. of the preceding solution added, and concentrated sulphuric acid perfectly free of nitrous products poured along the side of the tube, so as not to mix it with the solution therein. The heat evolved is generally sufficient to develop a coloration at the plane of separation, and the intensity of this color can be increased if necessary by gentle heating in the water-bath. If this product resulting from the treatment of cotton is brought up to 1 part in 1000, the resorcine will give an orange, the alpha-naphthol a purple, the gallic acid a green, becoming gradually violet down in the acid, the hydroquinone and the pyrogallol a brown, the morphine and codeine a nice lavender, the thymol and menthol a pink color, etc.

The extreme sensitiveness of these reactions allows us to characterize cotton, even in dyed goods, using bone-black to decolorize the solution if absolutely necessary. An approximation as to the quantity of cellulose can be obtained by comparing the intensity of the coloration to the one given by a solution of cotton of a known strength.

As we have lately indicated, the oxycellulose, owing to its aldehydic function, gives, too, with the phenols, colored reac-

[1] Read before the Rhode Island Section, June 15, 1899.

tions and could be used to characterize the cellulose, but in the presence of wool, the formation of oxycellulose is more difficult than the transformation of cellulose into carbohydrates.

EDM. JANDRIER.

Repairing Beckmann Thermometers.—It often happens that a Beckmann thermometer is broken, leaving the inner tube, containing the mercury, intact.

I have repaired such breaks as follows:

Select a piece of glass of the same kind as is used in the thermometer (usually Jena glass) of sufficient length to take the full length of the scale, plus the length necessary to make the joint come below the scale. This is necessary in order to avoid a joint opposite the scale which would make the reading inaccurate or impossible.

Cut off the broken end at the proper point, and wrap the inner tube with a piece of asbestos three or four inches long, tying it on with a piece of wire. Slide the asbestos down until the middle of it is opposite the place where the joint is to be. Slip the large tube over the inner tube and make the joint with a small flame from a blast-lamp. Cool, and dissolve the wire from the asbestos in a suitable acid. Wash out the asbestos, and dry with alcohol and ether. Insert the scale and put on the cap.

The thermometer is practically as good as new if the joint has been properly made. Anyone who can make a *good* joint can repair a thermometer in this way.

J. C. CHRISTENSEN.

NEW BOOKS.

INDICATORS AND TEST-PAPERS: THEIR SOURCE, PREPARATION, APPLICATION AND TESTS FOR SENSITIVENESS. A Résumé of the Current Facts regarding the Action and Application of the Indicators and Test-papers which have been Proposed from Time to Time, and are in Present Use in Chemical Manipulations, with a Tabular Summary of the Application of Indicators. Designed for the use of Chemists, Pharmacists, and Students. BY ALFRED I. COHN, PH.G. New York: John Wiley & Sons. 1899. pp. ix + 249. Price, $2.00.

A practically very useful compilation of the methods of preparation, uses, and tests for a very large number of indicators and

test-papers is given. The work is, unfortunately, defective in its theoretical discussions. While a very brief and not altogether satisfactory chapter is given on the theory of indicators as based on the modern theory of solutions, no use is made of the theory in other parts of the book. Statements with regard to individual indicators are almost exclusively from the purely empirical standpoint.

The theory of F. Mohr, on p. 19, can scarcely be considered otherwise than as a historical curiosity and would have been better omitted. WILLIAM A. NOYES.

A COURSE IN QUANTITATIVE CHEMICAL ANALYSIS, GRAVIMETRIC AND VOLUMETRIC. BY NICHOLAS KNIGHT, A.M., Ph.D., New York: A. S. Barnes & Co., 1899. x + 110 pp. Price, 80 cents.

This book is offered as a course which "will constitute a sufficient basis for advanced work in organic chemistry, including the ultimate analysis of substances by combustion, and for industrial chemistry which requires quantitative methods." After a brief general introduction in regard to the care of the balance, precipitation, filtering, etc., the author devotes fifty pages to the methods of gravimetric analysis.

The choice of examples for practice is not all that can be desired. In the preliminary operations the directions given are not adequate for a beginner in analytical chemistry, neither in detail nor in substance, and do not form a sufficient foundation for the student to continue with such complex analyses as those of smaltite, tetrahedrite, and granite. The schèmes for the analysis of these more complex substances would be much better suited to qualitative than to quantitative analysis, no attempts having been made to utilize the more recent and more special methods. The directions are often arbitrary and always mechanical, lacking in clearness, and with no attempt to explain the course of any reaction. Even if the student were entirely familiar with his general chemistry, he would have much trouble in trying to learn the whys and wherefores of analytical methods.

Twenty pages are devoted to volumetric analysis in the same arbitrary mechanical style. It would be useless to criticize this part of the book as well as the *seven* pages devoted to the analysis of drinking-water inasmuch as the whole of it shows a woeful lack of intimacy with the subject. The less said of the English in the book, the better; it is inexcusable.

With the many excellent treatises on analytical chemistry which can now be obtained, it is inconceivable why a new book altogether lacking in merit, should be published unless it offers new features either in contents or method.

HENRY FAY.

ERRATUM.

On page 935, October number, the symbol for rubidium persulphate should read $Rb_2S_2O_8$ or $RbSO_4$.

BOOKS RECEIVED.

Cultivation of Cigar-leaf Tobacco in Florida. By Marcus L. Floyd. Report No. 62, U. S. Department of Agriculture. Washington: Government Printing Office. 1899. 31 pp., with illustrations and plates.

Essentials of Medical Chemistry, Organic and Inorganic, containing questions of Medical Physics, Chemical Philosophy, Analytical Processes, Toxicology, Etc., prepared especially for Students of Medicine. By Lawrence Wolff, M.D. Fifth Edition, Thoroughly Revised by Smith Ely Jelliffe, M.D., Ph.D. Philadelphia: W. B. Saunders. 1899. 222 pp. Price, $1.00.

The Chemistry of Soils and Fertilizers. By Harry Snyder, Professor of Agricultural Chemistry in the University of Minnesota. Easton, Pa.: The Chemical Publishing Co. 1899. ix+277 pp. Price, $1.50.

Practical Methods for Determining Molecular Weights. By Henry Biltz, Privatdocent at the University of Greifswald. Translated (with the Author's Sanction) by Harry C. Jones, associate in Physical Chemistry in Johns Hopkins University, and Stephen H. King, M.D., Harvard University. Easton, Pa.: The Chemical Publishing Co. 1899. ix+235 pp. Price, $1.50.

Determination of Radicals in Carbon Compounds. By Dr. H. Meyer. Authorized translation by J. Bishop Tingle. New York: John Wiley & Sons. 1899. x+133 pp.

Preliminary Catalogue of Plants Poisonous to Stock. By V. K. Chesnut, B.S. Reprinted from the Annual Report of the Bureau of Animal Industry for 1898. 40 pp.

Experiments on the Metabolism of Matter and Energy in the Human Body. By W. O. Atwater and F. G. Benedict, with the cooperation of A. W. Smith and A. P. Bryant. U. S. Department of Agriculture, Washington, D. C. 1899. 112 pp.

Laboratory Manual. Experiments to Illustrate the Elementary Principles of Chemistry. By H. W. Hillyer, Ph.D. New York: The Macmillan Co. 1899. 200 pp. Price, 90 cents.

Index to Vol. XXI, 1899.

ACONITIC acid, derivatives of 381
Albumen, artificial 82
Albumin, egg 477
Alchemical metals, exhibition of 89
Alkaloids, extraction and estimation of 232
Alkali soil in Montana, notes on 753
Alumina, direct determination in presence of iron, manganese, calcium and magnesium 776
Anthracite coal, determination of volatile combustible matter in 1137
Antimony in ores, determination of 780
Applied chemistry, review of progress in 1145
Arsenic, determination in glycerine, 133, 388; determination in Paris green 769
Arsenic in ores, modification of Pierce's method for the determination of 431
ATTIX, JAMES C. See Meade, Richard K.
Atomic weight of palladium 943
Atomic weights, sixth annual report of the committee on, 200; of tungsten 373
AUCHY, GEORGE. Notes on the Rapid Determination of Tungsten in Steel 239

BALANCE for use in courses in elementary chemistry 31
BALTZLEY, EDWIN B. See Mabery, Charles F.
BANCROFT, WILDER D. The Relation of Physical Chemistry to Technical Chemistry 1101
Barium, strontium, and calcium sulphates, theory of the separation of 522
Barytocelestites, on the constitution of 386
BASKERVILLE, CHARLES. On the Universal Distribution of Titanium 1099
Baumé's hydrometer, table for, 119; corrections in (note) 388
BENEDIKT, FRANCIS G., and Olin F. Tower. The use of compressed oxygen in elementary organic analysis and of soda-lime in the quantitative determination of carbon dioxide 389
BENNETT, J. F., JR. A Modification of Pierce's Method for the Determination of Arsenic in Ores 431
Benzoic acid, influence of substituents on electrolytic conductivity of 792
Benzoin and benzil, an electrolytic study of 889
Berberine, assay of hydrastis canadensis for 732
Berzelius memorial services, correspondence relating to 300
Bismuth, electrolytic determination and separation 925
Bitumens, determination of sulphur in 772
Boiler water, sodium aluminate as a reagent for purifying 23
Boiling-point curves, some 994
BOOK REVIEWS. Elements of General Chemistry with Experiments (John H. Long), 103; Introduction to Chemical Technical Analysis (Ulzer-Fraenckel-Fleck), 105; Commercial Organic Analysis, Vol. IV (A. H. Allen), 106; Manual of Determinative Mineralogy with an Introduction on Blowpipe Analysis (Brush-Penfield), 107; A Text-Book of Volumetric Analysis with Special Reference to the Volumetric Processes of the Pharmacopoeia of the United States (Schimpf), 110; Commercial Organic Analysis, Vol. I (Allen), 111; Lehrbuch der anorganischen Chemie (Erdmann), 111; Preliminary Report of an Investigation of Rivers and Deep Ground Waters of Ohio as Sources of Public Water Supplies (State Board of Health), 113; Chemische Technologie an der Universitäten und technischen Hochschulen Deutschlands (F. Fischer), 302; Laboratory Work in Physiological Chemistry (Novy), 303; Electrolysis and Electrosynthesis of Organic Compounds (Löb-Lorenz), 304; Michael Faraday, His Life and Work (S. P. Thompson), 305; Text-Book of Medical and Pharmaceutical Chemistry

(E. H. Bartley), 306; Essentials of Materia Medica, Therapeutics and Prescription Writing (H. Morris), 307; A Manual of Chemical Analysis, Qualitative and Quantitative (G. S. Newth), 308; An Introductory Course of Quantitative Chemical Analysis with Explanatory Notes and Stoichiometrical Problems (H. P. Talbot), 311; Inorganic Chemistry According to the Periodic Law (Venable and Howe), 312; Commercial Organic Analysis, Vol. 2, Part I (Allen), 314; The Outlines of Industrial Chemistry (F. H. Thorp), 470; The Practical Compounding of Oils, Tallow and Grease for Lubrication, etc., 471; Lighting by Acetylene (W. E. Gibbs), 471; Lavas and Soils of the Hawaiian Islands (W. Maxwell), 472; Testing Milk and its Products (Farrington and Woll), 474; Massanalytische Studien (J. Wagner), 550; Organic Chemistry (Richter-Anschütz), 708; Traité d'analyse chimique quantitative par electrolyse (J. Riban), 708; Physical Chemistry for Beginners (Ch. van Deventer), 710; The Elements of Physical Chemistry (J. Livingston R. Morgan), 710; The Microscopy of Drinking Water (George Chandler Whipple), 711; The Spirit of Organic Chemistry (Arthur Lachman), 711; Die chemische Energie der Leben den Zellen (O. Loew), 713; A History of Physics in its Elementary Branches Including the Evolution of Physical Laboratories (Florian Cajori), 714; Chemistry and Metallurgy Applied to Dentistry (Vernon J. Hall), 715; A Treatise on Photographic Optics (R. S. Cole), 716; Anleitung zur Darstellung chemischer Praparate (H. Erdmann), 717; A Digest of Metabolism Experiments in which the Balance of Income and Outgo was Determined (W. O. Atwater), 804; The Arithmetic of Chemistry (John Waddell), 805; The Discharge of Electricity through Gases (J. J. Thomson), 1060; Easy Experiments of Organic Chemistry (J. H. Appleton), 1061; A select Bibliography of Chemistry, 1492-1897 (H. C. Bolton), 1062; School Chemistry (Charles Baskerville), 1063; A Short History of the Progress of Scientific Chemistry in our own times (William A. Tilden), 1063; Examination of Water, Chemical and Bacteriological (William P. Mason), 1065; The Liquefaction of Gases (J. Cauro), 1065; Elementary Studies in Chemistry (Joseph Torrey), 1066; The Mineral Industry (R. P. Rothwell), 1067; The Rise and Development of the Liquefaction of Gases (W. L. Hardin), 1068; Qualitative Analysis for Secondary Schools (Cyrus W. Irish), 1069; The Elements of Blowpipe Analysis (Frederick Hutton Getman), 1069; A Treatise on the Kinetic Theory of Gases (S. H. Burbury), 1070; Inorganic Chemical Preparations (Felix Lengfeld), 1071; The Elements of Qualitative Analysis (W. A. Noyes), 1072; The Compendious Manual of Qualitative Analysis of C. W. Eliot and F. H. Storer as Revised by W. R. Nichols (W. B. Lindsay), 1073; Indicators and Test-Papers (Alfred I. Cohn), 1176; A Course in Qualitative Chemical Analysis, Gravimetric and Volumetric (Nicholas Knight), 1177.

Books Received 114, 216, 315, 475, 556, 635, 805, 942, 1073, 1178
Boric acid, test for, 417; in tourmaline, quantitative estimation of 858
BOURGOUGNON, A. On the Determination of Sulphur in Sulphites (Note) 469
BREGOWSKY, J. M. See Ford, Allen P.
BROWN, THOMAS, JR. The Determination of Antimony in Ores 780
BROWNE, C. A., JR. A Contribution to the Chemistry of Butter-fat. I. The Physical and Chemical Constituents of Butter-fat, 612; II. The Chemical Composition of Butter-fat, 807; III. The Chemistry of Rancidity in Butter-fat 975
Brucine, estimation of 235
Burette, improved, 42; method for cleansing 302
Butter, on the Reichert figure of 938
Butter-fat, physical and chemical constants of, 612; chemical composition of 807; the chemistry of rancidity in 975

CADMIUM, electrolytic determination 911, 925
Calcium and magnesium in ashes, determination of 508
CAMPBELL, E. D. See Hess, William H.
Caramel in spirits and vinegar, detection of 355
Carbides, classification, mode of formation and reactions 647
Carbohydrates, notes on estimation of 369

Carbon combustions in a platinum crucible, 557; determination in substances containing nitrogen, 596; determination of graphitic, in cast and pig iron..... 1113
Carbon dioxide, use of soda-lime in determination of..... 389
Carbon monoxid, determination of 368
Cesium, new method for the preparation of 259; specific gravity of, 420; persulphate 934
CHAPIN, EDWARD S. See Noyes, A. A.
Chlorides, surface-tension of aqueous solutions of alkaline..... 411
Chlorine solutions, the color of..... 1038
Chromium in steel, the determination of (Note), 1039; salts, the nature of the change from violet to green in solutions of..... 1075
CHRISTENSEN, J. C. Repairing Beckmann Thermometers (Note)..... 1176
CLARK, THOMAS. On β-heptylamine..... 1027
CLARKE, CHARLES H., and Edgar F. Smith. The Electrolytic Oxidation of Succinnic Acid 967
CLARKE, F. W. Sixth Annual Report of the Committee on Atomic Weights..... 200
Coal analysis, report of the committee on..... 1116
COBLEIGH, W. M. See Traphagen, F. W.
COBURN, D. L. See Hopkins, Erastus.
Cocaine, new test for, 634; the chromic acid test for..... 936
Coke, determination of volatile combustible matter in 1137
Copper, electrolytic determination and separation, 924; by zinc, the precipitation of 932
Corn kernel, improvement in the chemical composition of the..... 1039
Correction, a..... 556
COTTLE, GEORGE. See Noyes, A. A.
Cotton, detection in woolen goods..... 1175
Coumarin, separation and estimation in flavoring extracts..... 256
CRAMPTON, C. A., and F. D. Simons. Detection of caramel in spirits and vinegar.. 355

DAINS, F. B. On the isourea ethers and other derivatives of ureas 136
DAVIS, B. J. See Kahlenberg, L.
DECHALMOT, G. Commercial Iron Silicides with a High Percentage of Iron: Their Properties, Manufacture and Uses..... 59
DENNIS, L. M., and C. G. Hopkins. The Determination of Carbon Monoxide, Methane and Hydrogen by Combustion..... 398
DUDLEY, C. B. See Noyes, William A.
Dynamite and gelatine dynamite, notes on the analysis of..... 425

EBAUGH, CLARENCE, and Edgar F. Smith. Action of Hypophosphorus Acid upon Molybdic Acid..... 384
Electric heater adapted for use in ether extraction..... 42
Electrolytes, effect of di-ionic electrolytes on the solubility of tri-ionic 511
Electrolytic determinations and separations..... 911
Elementary organic analysis, use of compressed oxygen in..... 389
ELLMS, JOSEPH W. A Study of the Relative Value of Lacmoid, Phenacetolin, and Erythrosine, as Indicators in the Determination of the Alkalinity of Water by Hehner's Method 359
EMERY, SIDNEY S. Baumé's Hydrometer—American Standard, Calculated by, 119; Corrections in Baumé's Hydrometer Tables..... 388
Emetine octoiodide..... 231
ERDMANN, HUGO, and A. E. Menke. New Method for the Preparation of Cesium .. 259
Errata 556, 718, 942, 1178
Erythrosine, use in water analysis..... 360
Ethane, absorption by fuming sulphuric acid..... 245
Ether extraction, electric heater adopted for use in, 42; incandescent electric lamp as a source of heat in..... 645
Explosions caused by commonly occurring substances (Presidential address)..... 317

FAUST, JNO. KIRK. See Sargent, Geo. Wm.
Fermentation, without cells, address on, 77; American methods of 83

FERNBERGER, HARRY M., and Edgar F. Smith. The Electrolysis of Metallic Phosphate Solutions 1001
Ferrous solutions, convenient method for maintaining reduction of (Note) 103
Filtering medium, a new 287
Flour, examination of commercial 650
FORD, ALLEN P., and I. M. Bregowsky. The Determination of Graphitic Carbon in Cast and Pig Iron 1113
Formic aldehyde, oxidation by hydrogen peroxide 262
FOSTER, ARNOTT R., and Edgar F. Smith. The Persulphates of Rubidium, Cesium, and Thallium 934
FOWLER, R. E. See Kahlenberg, L.
FRANKFORTER, G. B., and E. P. Harding. A Chemical Study of Wheat 758
FRIEDBURG, L. H. On Recent Progress in Photochemistry (review) 445

GASES, apparatus for analysis of illuminating and fuel 1108
GEISLER, JOSEPH F. Paraffin as an adulterant of oleomargarine 605
GILL, AUGUSTUS H., and Israel Hatch, Jr. The heat of bromination test for oils 27
GILL, AUGUSTUS H., and Augustus C. Lamb. The analytical constants of American linseed oil 29
GLENN, WM. A method for cleansing burettes (Note) 302
Glycollic acid: one of the acids of sugar-cane 45
Gold, electrolytic separations 921
GORDIN, H. M., and A. B. Prescott. Emetine Octoiodide and the Extraction and Estimation of Alkaloids Generally, 231; Hydrastine Hexaiodide and the Assay of Hydrastis Canadensis by Means of Standard Iodine for Hydrastine and of Standard Potassium Iodide for Berberine 732
GOTTHELF, A. H. See Morgan, J. Livingston R.
Graphitic carbon in cast and pig iron, determination of 1113
GRIFFIN, MARTIN L. The Comparative Value of Certain Reagents for Removing Lime and Magnesia from Natural Waters for Industrial Uses 665

HANNA, D. C., and Edgar F. Smith. Observations on Derivatives of Aconitic Acid 381
Hard water, action of, on certain metals 422
HARDIN, WILLET LEPLEY. Derivatives and Atomic Mass of Palladium 943
HARDING, E. P. See Frankforter, G. B.
HARTWELL, B. L., and H. J. Wheeler. On a Possible Error in the Determination of Nitrogen in Nitrates Due to Impurities in Reduced Iron (Note), 468; See Wheeler, H. J.
HATCH, ISRAEL, JR. See Gill, Augustus H.
Hawaiian soils, estimation of available fertilizing ingredients in 415
HAYWOOD, J. K. Determination of Calcium and Magnesium in Ashes, 508; Some Boiling-point Curves 994
Heat of bromination test for oils 27
β-Heptylamine 1027
HESS, WILLIAM H. The Distinction of True Extract of Vanilla from Liquid Preparations of Vanillin 719
HESS, WILLIAM H., and Albert B. Prescott. Coumarin and Vanillin, their Separation, Estimation and Identification, in Commercial Flavoring Extracts 256
HESS, WILLIAM H., and E. D. Campbell. A New Method for the Direct Determination of Alumina in Presence of Iron, Manganese, Calcium and Magnesium 776
HILLEBRAND, W. F. See Noyes, William A.
HOPKINS, C. G. How to Ignite a Hydrogen Jet with No Possibility of Exploding the Generator (Note), 634; The Incandescent Electric Lamp as a Source of Heat in Ether Extraction, 645; Improvement in the Chemical Composition of the Corn-kernel, 1039; See Dennis, L. M.
HOPKINS, ERASTUS, D. L. Coburn, and Edw. Spiller. Analytical Research on "Sod Oil" 291
HOWE, JAS. LEWIS, and J. L. Morrison. Action of a Hard Water on Certain Metals 422
Humus in soils, amount of, and percentage of nitrogen in, as affected by air-slaked lime, etc 1032

HYDE, F. S. A Method of Analysis for Canned Condensed Milk, 439; Preparation of Graphitoidal Silicon 663
Hydrastine hexaiodide and the assay of hydrastis canadensis 732
Hydrochloric acid gas, separations by means of, 642; action upon sulphates, selenates, tellurates, and phosphates 929
Hydrogen, determination of 398
Hydrogen, determination in substances containing nitrogen 596
Hydrogen jet, how to ignite without danger of explosion, 634; hydrogen sulphide precipitations, apparatus to facilitate 421

INDICATORS for alkalinity in water analysis 359
Inversion of sugar by salts 1
Iodine, solubility in dilute potassium iodide solution 217
Iron, electrolytic determination of 928
Iron silicides with a high percentage of silicon, properties, manufacture, and uses 59
Isourea ethers and other derivatives of ureas 136

JAMES, JOSEPH H. An Electrolytic Study of Benzoin and Benzil 889
JANDRIER, EDM. Chemical Detection of Vegetable Fibers (Note) 1175

KAHLENBERG, L., B. J. Davis, and R. E. Fowler. The Inversion of Sugar by Salts 1
KASTLE, J. H., and A. S. Loevenhart. The Oxidation of Formic Aldehyde by Hydrogen Peroxide 262
Ketones, action of sodium methylate upon unsaturated 955
KOLLOCK, LILY G. Electrolytic Determinations and Separations 911
KRAEMER HENRY. An Examination of Commercial Flour 650

LABORATORIES in Vienna 93
Lacmoid, preparation and use in water analysis 360
LAMB, AUGUSTUS C. See Gill, Augustus H.
LANGMUIR, A. C. A New Method for the Determination of Zinc, 115; The Determination of Arsenic in Glycerine, 133, 388; Drown's Method of Determining Silicon (Note) 215
LENHER, VICTOR. Preparation of Metallic Tellurium 347
LENHER, VICTOR, and J. S. C. Wells. Tests for Boric Acid 417
Light in sugar production, influence of 53
LINEBARGER, C. E. On a Balance for Use in Courses in Elementary Chemistry 31
The surface-tensions of aqueous solutions of alkaline chlorides, 411; a simple volumenometer 435
Linseed oil, the analytical constants of American 29
LONG, J. H. On the Optical Rotation of Pinen Hydrochloride 637
LOEVENHART, A. S. See Kastle, J. H.

MABERY, CHARLES F., and Edwin B. Baltzley. Sodium Aluminate as a Means for the Removal of Lime and Suspended Matter from Water for Use in Boilers 23
MACKAY, P. A. Analysis of Zinc for Cadmium and Lead (Note) 940
Magnesium, a new volumetric method for, 746; in ashes, determination of calcium and 503
MAHON, R. W. The Determination of Chromium in Steel (Note), 1057; Addendum Gravimetric Determination of Manganese in Steel (Note) 1060
Maize, composition and products, 85; improvement in the chemical composition of 1039
Manganese in steel, gravimetric determination of (note) 1060
MATHEWS, J. A. Classification of the Carbides: Their Mode of Formation and Reactions of Decomposition 647
MAXWELL, WALTER. Estimation of the Lime, Potash, and Phosphoric Acid in Hawaiian Soils Probably Available for the Immediate Crop, 415. See Pond, F. J.
MCILHINEY, PARKER C. The Determination of the Bromine Absorption of Oils 1084
MCKENNA, CHAS. F. A New Apparatus for the Determination of Volume 50
MCMURTRIE, WM. Some Records of Progress in Applied Chemistry (Review) 1145
MEADE, R. K. An Apparatus to Facilitate Hydrogen Sulphide Precipitations, 421; A

New Volumetric Method for Magnesium 746
MEADE, RICHARD K., and James C. Attix. On the Determination of Volatile Combustible Matter in Coke and Anthracite Coal 1137
MENKE, A. E. The Specific Gravity of Cesium, 420. See Erdmann, Hugo.
Mercury, electrolytic determination and separation 916, 927
Methane, absorption by fuming sulphuric acid, 245; determination of 398
Milk, analysis of canned condensed, 439; determination of added water in 503
Molecular weights of liquids 282, 725
Molybdic acid, action of hypophosphorous acid upon 384
MORGAN, J. LIVINGSTON R. The Theory of the Separation of Barium, Strontium, and Calcium from the Mixed Sulphates 522
MORGAN, J. LIVINGSTON R., and A. H. Gotthelf. The Theory of the Formation of Nickel Sulphide 494
MORRISON, J. L. See Howe, Jas. Lewis.
MOYER, J. BIRD. Separations of Metallic Sulphides by Means of Hydrochloric Acid Gas 642
MUNROE, C. E. Explosions Caused by Commonly Occurring Substances (Presidential Address) 317
MURRILL, PAUL. Halides and Perhalides of the Picolines 828
MYERS, JOHN A. A Review of the Present Knowledge of Sodium Nitrate, Together with the Origin, Production and Destruction of Nitrates in the Soil 455
MYERS, WILLIAM S. A Convenient Method for Maintaining Reduction of Ferrous Solutions (Note) 103

NICKEL in nickel steel, determination of 854
Nickel sulphide, theory of the formation of 486
Nitrates, error in the determination of 468
Nitrates in the soil, production and destruction of 455
Nitrogen in nitrates, error in the determination of 468
Nitrogen in fertilizers containing nitrates, determination of 1094
NORMAN, G. M. See Pond, F. J.
NOTES. A Method for Cleansing Burettes (William Glenn), 302: Corrections in Baumé's Hydrometer Tables (A. C. Langmuir), 388; The Determination of Arsenic in Glycerine (Sidney S. Emery), 388; On a Possible Error in the Determination of Nitrogen in Nitrates Due to Impurities in Reduced Iron (Hartwell and Wheeler), 468; On the Determination of Sulphur in Sulphites (A. Bourgougnon), 469; Fuller's Earth (F. J. Schreiber), 470; How to Ignite a Hydrogen Jet with no Possibility of Exploding the Generator (C. G. Hopkins), 634: A New Test for Cocaine (George L. Schaefer), 634: The Occurrence of Vanadium, Chromium, and Titanium in Peats (Charles Baskerville), 706; On the Reichert Figure of Butter (James H. Stebbins), 938: Analysis of Zinc for Cadmium and Lead (P. A. Mackay), 940; Chemical Detection of Vegetable Fibers (Edm. Jandrier): Repairing Beckmann Thermometers (J. C. Christensen) 1176
NOYES, A. A., and Edward S. Chapin. The Effect of Di-ionic Electrolytes on the Solubility of Tri-ionic Electrolytes with Different Ions 511
NOYES, A. A., and George Cottle. The Velocity of the Reaction between Silver Acetate and Sodium Formate. A Reaction of the Third Order 250
NOYES, A. A., and L. J. Seidensticker. The Solubility of Iodine in Dilute Potassium Iodide Solutions 217
NOYES, WILLIAM A., W. F. Hillebrand, and C. B. Dudley. Report of the Committee on Coal Analysis 1116
Nux vomica, assay of 351

OILS, the heat of bromination test for, 27; determination of the bromine absorption of 1084
Oleomargarine, paraffin as an adulterant of 605
Organic elementary analysis, determination of carbon and hydrogen in substances containing nitrogen 596
Osborne, Thomas B. Egg Albumin, 477; On Some Definite Compounds of Protein Bodies 486

PALLADIUM, derivatives and atomic mass of 943
Paraffin as an adulterant of oleomargarine 605
Paris green, determination of arsenic in 769
PECKHAM, S. F., and H. E. The Determination of Sulphur in Bitumens 772
Perhalides of quinoline 66
Persulphates of rubidium, cesium, and thallium 934
Phenacetolin, preparation and use in water analysis 360
Phosphates, action of hydrochloric acid gas upon 929
Phosphate solutions, electrolysis of metallic 1001
Phosphoric acid, direct determination of available 1090
Photochemistry, a review of recent progress in 445
Physical chemistry, relation to technical chemistry 1101
Picolines, halides and perhalides of the 828
Pinen hydrochloride, optical rotation of 637
Polariscope readings, correction for temperature in 568
POND, F. J., O. P. Maxwell, and G. M. Norman. The Action of Sodium Methylate upon Dibromides of Propenyl Compounds and of Unsaturated Ketones 955
Potash, determination as perchlorate 33
PRESCOTT, A. B. See Gordin, H. M., Hess, William H.
Propenyl compounds, action of sodium methylate upon dibromides of 955
Protein bodies, definite compounds of 486

QUINOLINE, perhalides of 66

REDUCTOR, a simplified 723
REVIEWS. Third International Congress of Applied Chemistry (H. W. Wiley), 73; On Recent Progress in Photochemistry (L. H. Friedburg), 445; A Review of the Present Knowledge of Sodium Nitrate, Together with the Origin, Production, and Destruction of Nitrates in the Soil (John A. Myers), 455; A Brief History of the Movement for Increasing the Accuracy and for Improving the Construction of Chemical Measuring Instruments (Ervin E. Ewell), 527; The Retort Coke Oven and the Chemistry of its By-products (J. D. Pennock), 678; Some Records of Progress in Applied Chemistry (Wm. McMutrie) 1145
RIEDERER, Emil J. Electrolytic Determination of Zinc in the Presence of Manganese 789
Rubidium persulphate 934

SAMMIS, J. L. Improved Apparatus 42
SARGENT, GEO. WM. The Determination of Nickel in Nickel Steel, 854; The Quantitative Estimation of Boric Acid in Tourmaline, 858; See Wheeler, H. J.
SARGENT, GEO. WM., and Jno. Kirk Faust. A New Filtering Medium 287
Saccharose, crystallization of amorphous 83
SARLES, E. H. Note on the Color of Chlorine Solutions 1038
SCHAEFER, GEORGE L. A New Test for Cocaine (Note), 634; The Chromic Acid Test for Cocaine 936
SCHREIBER, F. T. Fuller's Earth (Note) 470
SEIDENSTICKER, L. J. See Noyes, A. A.
Selenates, action of hydrochloric acid gas upon 929
SHENGLE, JOHN C., and Edgar F. Smith. The Precipitation of Copper by Zinc 932
SHIMER, P. W. Silica and Insoluble Residue in Portland Cement, 289; Carbon Combustions in a Platinum Crucible, 557; A Simplified Reductor 723
SHIVER, F. S. The Determination of Potash as Perchlorate 33
SHOREY, EDMUND C. Glycollic Acid: One of the Acids of Sugar-cane, 45; Xanthine Bases in Sugar-cane 609
Silica and insoluble residue in Portland cement 289
Silicates, solubility in water of certain natural 437
Silicides of iron, properties, manufacture and uses 59
Silicon, Drown's method of determining, 215; preparation of graphitoidal 663
Silver, electrolytic determination and separation 912
Silver acetate and sodium formate, velocity of reaction between 250
SIMONS, F. D. See Crampton, C. A.

SMITH, EDGAR F. Observations upon Tungsten, 1007; See also Clarke, Charles H.; Fernberger, Harry M.; Hanna, D. C.; Ebaugh, Clarence; Tunnell, Raymond; Shengle, John C.; Foster, Arnott R.
SMITH, F. W. Notes on the Analysis of Dynamite and Gelatine Dynamite 425
SMITH, THORN. The Estimation of Arsenic in Paris Green 769
Sod oil, analytical research on 291
Soda-lime in determination of carbon dioxide, use of 389
Sodium, aluminate as a means for the removal of lime and suspended matter from water for use in boilers, 23; formate and silver acetate, velocity of reaction between, 250; nitrate, review of present knowledge of 455
Soil in Montana, notes on alkali 753
Soils, notes upon testing, for application of commercial fertilizers 1095
SPEYERS, CLARENCE L. Molecular Weights of Liquids, III, 282; On van't Hoff's Equation and the Molecular Weights of Liquids 725
SPILLER, EDW. See Hopkins, Erastus.
Spirits, detection of caramel in 355
SQUIBB, EDWARD R. The Assay of Nux Vomica 351
STEBBINS, JAMES H. Upon the Action of Sulphuric Acid on Thymol, 276; Upon the Action of Diazo-compounds on Thymol Parasulpho Acid, 741; On the Reichert Figure of Butter (Note) 938
STEIGER, GEORGE. The Solubility in Water of Certain Natural Silicates 437
Strychnine, estimation of 235
Succinic acid, electrolytic oxidation of 967
Sucrose, influence of temperature on specific rotation of, 84; influence of temperature on specific rotating power of, and method of correcting readings of compensating polariscopes therefor 568
Sugar, inversion by salts, 1; production, light a factor in, 53; analysis, international commission on 87
Sulphates, action of hydrochloric acid gas upon 929
Sulphides, separation of metallic, by means of hydrochloric acid gas 642
Sulphur, determination in sulphites, 469; in bitumens, determination of, 772; in pig iron, notes on the determination of 972
Surface-tensions of aqueous solutions of alkaline chlorides 411

TECHNICAL chemistry, relation of physical chemistry to 1101
Tellurates, action of hydrochloric acid gas upon 929
Tellurium, preparation of metallic, 347; persulphate 934
Thermometers, repairing Beckmann 1176
THOMAS, GEORGE EDWARD. The Atomic Mass of Tungsten and the Preparation of Sodium Pertungstate by Means of the Electric Current 369
Thymol, action of sulphuric acid on 276
Thymolparasulpho acid, action of diazo-compounds on 741
TINGLE, ALFRED. The influence of substituents on the electrolytic conductivity of benzoic acid 792
Titanium, universal distribution of 1099
TOWER, OLIN F. The Determination of Carbon and Hydrogen in Organic Substances Containing Nitrogen, 536. See Benedikt, Francis.
TRAPHAGEN, F. W., and W. M. Cobleigh. Some Notes on the Estimation of Carbohydrates, 369; Notes on Alkali Soil in Montana 753
TROWBRIDGE, P. F. Perhalides of Quinoline 66
Tungsten, atomic mass of, and preparation of sodium pertungstate 369
Tungsten, observations upon 1007
Tungsten in steel, rapid determination of 239
TUNNELL, RAYMOND, and Edgar F. Smith. Action of Hydrochloric Acid Gas upon Sulphates, Selenates, Tellurates and Phosphates 929

VALENCE, nature of 192, 220
Vanilla, distinction between true extract of, and liquid preparations of vanillin 719
Vanillin, separation and estimation in flavoring extracts 256

Van 't Hoff equation 725
Vegetable fibers, detection of 1175
VEITCH, F. P. The Direct Determination of Available Phosphoric Acid, 1090; Note upon the Determination of Nitrogen in Fertilizers Containing Nitrates 1094
VENABLE, F. P. The Nature of Valence 192, 220
Vinegar, detection of caramel in 355
VOLNEY, C. W. On the Constitution of Barytocelestites 386
Volume, new apparatus for the determination of 50
Volumenometer, a simple 435
Volumetric analysis, graduation of apparatus for 527, 550

WATER, action of a hard, on certain metals 422
Water analysis, relative value of indicators for alkalinity in 359
Water for boilers, sodium aluminate as a reagent for purifying 23
Water purification, comparative value of reagents for 665
WEBER, H. A. Light a Factor in Sugar Production, 53; Notes on Testing Soils for Application of Commercial Fertilizers 1095
WELLS, J. S. C. See Lenher, Victor.
Wheat, chemical study of 758
WHEELER, H. J., C. L. Sargent, and B. L. Hartwell. The Amount of Humus in Soils and the Percentage of Nitrogen in the Humus as Affected by Application of Air-slaked Lime and Certain Other Substances, 1032. See Hartwell, B. L.
WHITNEY, W. R. The Nature of the Change from Violet to Green in Solutions of Chromium Salts 1075
WILEY, H. W. Third International Congress of Applied Chemistry (Review), 73; The Influence of Temperature on the Specific Rotation of Sucrose and Method of Correcting Readings of Compensating Polariscopes Therefor 568
WOODMAN, A. G. On the Determination of Added Water in Milk 503
WORSTALL, R. A. The Absorption of Methane and Ethane by Sulphuric Acid 245

XANTHINE bases in sugar-cane 609

ZINC, new method for determination of, 115; electrolytic determination in presence of manganese, 789; analysis for cadmium and lead 940

Issued with January Number, 1899.

Proceedings.

COUNCIL.

The salary of the editor for 1898 has been fixed at two hundred and fifty dollars ($250).

The number of pages in the December number of the Journal was ordered increased to not over 175.

The Committee on Life Membership Fund, appointed at the meeting of the Council, August 22, 1898, has reported as follows:

To the President and Council of the American Chemical Society:

GENTLEMEN—Your Committee on the Life Membership Fund has the honor to report that it finds that the following persons have been enrolled as life members or as life associate members.

Life Members—C. F. Chandler, W. M. Habirshaw, T. S. Hunt, W. P. Mason, E. Waller.

Life Associate Members—J. O. Donner, H. C. Havemeyer, T. A. Havemeyer, A. Kuttroff, W. Pickhardt, W. P. Prentice, C. H. Senff.

That the commutation fee for life members and life associate members is one hundred dollars, and that no money appears in the treasury to the account of any one of these persons; therefore your committee recommends that the treasurer be authorized and directed to take from the moneys in the treasury, not otherwise appropriated, twelve hundred dollars ($1,200), and invest this sum as provided for in Section 2, of Article X, of the Constitution of the American Chemical Society, as adopted December 2, 1897, and that the fund thus created be hereafter held and used as a life-membership fund as provided for in the section above cited.

Respectfully submitted,
CHARLES E. MUNROE,
CHAS. B. DUDLEY,
CHAS. F. MCKENNA.

This report was approved Dec. 12th, and the recommendations therein contained adopted by the Council.

NAMES PROPOSED FOR MEMBERSHIP.

Barnett, Edwin S., Mt. Alverno, Delaware Co., Pa.

Bossé, Karl K., 158 Waverly Place, New York City.
Bradley, Walter P., 242 High St., Middletown, Conn.
Brewster, Edward E., 316 E. C St., Iron Mountain, Mich.
Brush, Charles F., 1003 Euclid Ave., Cleveland, O.
Closson, C. D., Ohio Med. Univ., Columbus, O.
Coggeshall, George W., 13 Prescott Hall, Cambridge, Mass.
Cook, Robert A., 66 Maiden Lane, New York City.
Crane, Fred., 142 Walnut St., Montclair, N. J.
Dieckmann, Otto, 1182 Harrison Ave., Cincinnati, O.
Gallivan, Frank B., Polytechnic Institute, Brooklyn, N. Y.
Giddings, H. DeWitt, 173 Loomis St., Burlington, Vt.
Gruener, Hippolyte, Adelbert College, Cleveland, O.
Haigh, Frederic, 677 E. 24th St., Paterson, N. J.
Hardenburgh, Louis M., Iron Mountain, Mich.
Harris, Isham G., H. R. State Hospital, Poughkeepsie, N. Y.
Hesse, Bernard C., 128 Duane St., N. Y. City.
Hiltner, Martin E., 1301 N St., Lincoln, Nebr.
Kelly, Daniel J., U. S. Patent Office, Washington, D. C.
Kendall, Robert E., 96 Warren St., Glens Falls, N. Y.
Levene, Phoebus A., 1626 Madison Ave., N. Y. City.
Levison, W. Goold, Cooper Institute, N. Y. City.
Porter, Arthur F., 143 Lexington Ave., New York City.
Riddle, Robert N., Uwchland, Chester Co., Pa.
Rippetoe, J. J., Vallejo, Cal.
Sadtler, Samuel S., 235 Jefferson Ave., Brooklyn, N. Y.
Schuyler, Erwin H., Watertown High School, Watertown, N.Y.
Sovereign, Clarence L., 128 N. Winnebago St., Rockford, Ill.
Thatcher, Roscoe W., Beatrice High School, Beatrice, Nebr.
Thompson, Milton S., Box 1, Newburyport, Mass.
Von Egloffstein, Camill, 714 Bushwick Ave., Brooklyn, N. Y.
Welt, Ida, 814 Lexington Ave., New York City.
Wolff, Frank A., U. S. Coast and Geodetic Survey, Washington, D. C.

NAMES PROPOSED FOR ASSOCIATE MEMBERSHIP.

Becket, Fred. M., 310 W. 122d St., New York City.
Caldwell, John A., Jr., Cornell Univ., Ithaca, N. Y.
Duff, Wm. A., 310 W. 122d St., New York City.
Hall, Gaylord C., Box 506, Central Univ., Richmond, Ky.
Hildreth, Edward T., 87 University Road, Brookline, Mass.
Hoeppner, Josephine M., Pullman, Wash.
Kingsley, William J., 202 Broadway, N. Y. City.
Loeser, Robert M., Stanford Univ., Cal.
Lysle, Walter S., 223 Chartiers St., Allegheny, Pa.
Macdonald, N. L., Everett, Mass.
Meader, Arthur L., Norwood, Cincinnati, O.
Packer, Samuel C., 4263 Fergus St., Cincinnati, O.

Porter, John J., Station C, Cincinnati, O.
Ripley, Philip F., Andover, Mass.
Robeson, Anthony M., "The Gracemore," 120th St. and Morningside Ave., New York City.
Roller, Harry C., Cranford, N. J.

NEW MEMBERS ELECTED DECEMBER 27, 1898.

Aller, F. D., Maurer, N. J.
Bosart, Louis W., Jr., Home City, Hamilton Co., O.
Cairns, Fred. I., 246 Park Ave., Bridgeport, Conn.
Clementson, Henry, 316 Cumberland St., Brooklyn, N. Y.
Converse, William A., 29 to 33 Rialto Building, Chicago, Ill.
Duryea, Chester B., Sioux City, Iowa.
Ebersole, Morris R., Cornell University, Ithaca, N. Y.
Granja, Rafael, care of C. O. Mailloux, 150 Nassau St., N.Y. City.
Hirschmann, Morris, 1363 Prospect Ave., Brooklyn, N. Y.
Holden, Edward F., Lake Ave., Melrose, Mass.
Klein, Otto W., 280 Broadway, N. Y. City.
Means, R. F., 6 Custom House St., Boston, Mass.
Miller, Frank W., Univ. of N. C., Chapel Hill, N. C.
Ward, Delancey W., 247 Sanford Ave., Flushing, N. Y.
Wyatt, Francis, 39 South William St., N. Y. City.

ELECTED DECEMBER 30, 1898.

Meyer, Max, 157 W. 103d St., N. Y. City.

ASSOCIATES ELECTED DECEMBER 27, 1898.

Bursner, J. M., 802 Vine St., Cincinnati, O.
Faulkner, Joseph G., 2529 Chatham St., Cincinnati, O.
Fite, Campbell C., 1 Madison Ave., N. Y. City.
Hawkins, Clement C., 228 W. Seventh St., Cincinnati, O.
Masury, John W., 33 W. 71st St., N. Y. City.
Treiber, C., 372 Atlantic Ave., Boston, Mass.
White, Wm. T., Box 45, Lowell, Mass.

CHANGES OF ADDRESS.

Baker, Dicia H., 2217 8th St., Birmingham, Ala.
Bevier, Isabel, Lake Erie College, Painesville, O.
Souther, Henry, 438 Asylum St., Hartford, Conn.
Waller, Elwyn, 159 Front St., New York City.

MEETINGS OF THE SECTIONS.

WASHINGTON SECTION.

The regular meeting of the Washington Section was held on

November 10, 1898. The first paper of the evening was read by Mr. F. K. Cameron, and was entitled, "Some Boiling-point Curves for Mixtures of Miscible Liquids."

The general properties and significance of pressure-concentration, and temperature-concentration curves for pairs of perfectly miscible liquids were indicated, and the research of Konowaloff, Nernst, and others briefly cited. All the possible types now known were illustrated by some as yet unpublished data from a preliminary investigation by Cameron and Thayer.

A significant fact brought out by certain of these curves, notably the one for alcohol-chloroform mixtures, is that they possess not only a maximum and minimum point, but there is a decided sag in the opposite direction at another portion of the curve. So far no such curve is known which has both a maximum and minimum point, and the possibility of such a case has been denied by some authorities. But the fact just cited shows an indubitable tendency towards such a case and indicates that by a suitable choice of the constant factor (temperature or pressure) for some pair of liquids such a curve may yet be found. The great desirability of further experimental work in this field, both for theoretical and practical reasons, was indicated.

The second paper of the evening was by Mr. F. K. Cameron, and was entitled, "A Ternary Mixture."

Given a mixture of two perfectly miscible liquids, A and B, and a third substance C, soluble in one constituent of the pair. At a definite temperature there will be a separation of the liquid mixture into its constituents, this definite temperature being dependent on the relative concentrations of the solution. By keeping C in excess of the amount soluble the problem is somewhat simplified. The results of a preliminary investigation on the curve for temperatures of separation-concentration, presence of a third substance soluble in only one constituent, were presented. Further, the third substance C was varied for certain concentrations. And finally mixtures of the substances which had been used as C were tried. The results were interesting but no causal connection could be detected. It is essential that more experimental evidence shall be in our possession before a satisfactory theory of the phenomena will be possible.

The third paper was read by Dr. T. M. Chatard, and was entitled, "Note on the Rate of Loss in Cyanide Solutions."

Dr. Chatard exhibited a sheet of curves representing the rate of loss of cyanide in solutions used for the extraction of gold in the electrolytic sluice. There is always a certain loss due to oxidation of the cyanide through agitation of the solution during

the operation of the apparatus. Another loss results from the action of the ore on the solution. An electric current of about two-tenths ampere per square foot of cathode plate and of about two volts, is employed and it is desirable to know what effect such a current has upon the solutions which usually contain from 0.20 to 0.25 per cent. potassium cyanide at the start. Samples of the solution were taken at regular intervals during each run, the percentage of cyanide giving points of the curve.

When ore is treated, the curves usually show a rapid loss of cyanide during the first period of fifteen minutes, due to the action of the ore, the rate of loss then decreasing so that the final result is often a fairly regular curve. When the solution is run with neither ore nor current, the fall in strength is usually regular so that the line connecting any three consecutive points is practically straight. Using the customary current but no ore, other conditions being alike, the results indicate that the cyanide losses are lessened even though the tests are, as yet, too few for positive evidence. It may, however, be stated with confidence that the use of electricity, so important for the extraction of precious metals from ores and solutions, is not attended by any increased loss of the expensive cyanide.

The last paper was read by Dr. C. E. Munroe, and was entitled, "The Examination of Acid for Use in the Manufacture of Guncotton."

Dr. Munroe's paper contained a summary of work done by his assistants, Mr. G. W. Patterson and Mr. J. J. Tobin, and by him. The specifications for the acids given were accompanied by descriptions of the analytical methods and methods of calculation to be followed in the inspection of the acids supplied, and a comparison was made between these methods and others that have been proposed. Attention was called to the necessity of defining the substances present by the methods by which they are to be determined and reckoned, as it not infrequently happens that there are differences of opinion as to the form in which they occur and the methods for determining them, and a dispute is most easily avoided by a prior technical convention. Thus there is a difference of opinion as to the form in which a portion of the nitrogen present in these acids occurs, some regarding it as in the form of hyponitrous acid, others as nitrosulphuric acid, but without expressing any opinion on this point the specifications simply required that it should be determined in a carefully prescribed manner and reckoned as nitrogen tetroxide (N_2O_4) and that as thus determined and reckoned it should not exceed a certain percentage of the mixture.

The data of a considerable number of analyses showing the percentage composition and specific gravities of both original

acids and spent acids from the guncotton manufacture was given, and the differences between the amounts of sulphuric acid in the different operations was seen to be remarkably constant, showing the mixture to be well proportioned for this purpose.

Observations were made on the permanency of composition of the mixed acids stored in darkness and in sunlight; on the color of the acids as a criterion of the amount of nitrogen oxides present; on the change of color produced by heating them; on the freezing of the acids and the rate of expansion of different mixtures.

The specific gravity bottle used, which was devised by Professor Barker, and which was particularly adapted to this work, was exhibited.

WILLIAM H. KRUG, *Secretary.*

RHODE ISLAND SECTION.

The regular monthly meeting of the Rhode Island Section of the American Chemical Society was held at the Hope Club, Providence, October 27, 1898, with Mr. Edward D. Pearce as presiding officer.

Prof. J. H. Appleton, of Brown University, presented a paper on "Some Elements Recently Announced." The speaker discussed the substances proposed during the summer of 1898 as new elements: neon, metargon, krypton, xenon, etherion, coronium, monium, and polonium. In the paper all the facts and data respecting these substances, as far as published to date, were collected.

The regular monthly meeting of the Rhode Island Section of the American Chemical Society was held at the Hope Club, Providence, December 15, 1898, at 8 o'clock, with Mr. Edward D. Pearce as presiding officer.

After dinner the members and guests proceeded to the Chemical Laboratory of Brown University. Here Professor J. H. Appleton gave a lecture on "Experimentation in Organic Chemistry." His remarks were illustrated by experiments performed with simple appliances of his own invention. These experiments showed how a number of the facts and operations of organic chemistry may be demonstrated neatly, quickly, and conclusively.

The reduction of cupric oxide by sugar and the carbon dioxide formed were easily shown. The presence of nitrogen in al-

bumen was illustrated by two processes. Chlorine in chloroform was demonstrated by passing it through a hot tube and collecting the products of decomposition. All these experiments were performed by simple devices, easily made, and mark an improvement in qualitative work of this kind.

WALTER E. SMITH, *Secretary.*

NEW YORK SECTION.

The local section of the American Chemical Society held its regular meeting at the College of the City of New York on Friday evening, November 9, Dr. William McMurtrie presiding, and ninety-five members and visitors present. The following papers were read:

"Preliminary Note on Proposed Patent Legislation in its Relation to American Chemists," by C. C. Parsons.

"Atomic Weight as a Cyclic Function," by Thomas Bayley, England.

"Recent Progress in Photochemistry," by L. H. Friedburg.

"The Commercial Electrolysis of Salt in the United States," by H. Carmichael.

"Notes on the Electrolysis of Salt," by J. D. Pennock.

On motion the chair was authorized to appoint a committee of five to consider what action should be taken on proposed patent legislation.

The chairman reported that the Chemists' Club had been duly organized and the rooms leased, and it was expected that all necessary furnishing would be completed in time for the meeting of the general society in the holiday week.

The announcement was made that the membership of the section has passed the 300 mark, which, in accordance with the provisions of the new constitution, allows the section four representatives on the council.

The secretary was therefore directed by unanimous vote to cast a ballot electing the following gentlemen to represent the society: William McMurtrie, A. A. Breneman, C. A. Doremus, and A. H. Sabin, and in the event of any of these being elected councilors-at-large, Durand Woodman, J. B. F. Herreshoff, E. G. Love, E. E. Smith, Geo. C. Stone, and C. B. Voorhees as alternates in the order named.

The Executive Committee decided to postpone the next regular meeting of the section to Friday, January 13th, to avoid following the midwinter meeting too closely. The general secretary reported a number of papers already promised for the midwinter meeting, and all arrangements progressing favorably.

DURAND WOODMAN, *Secretary.*

CINCINNATI SECTION.

The sixty-fourth regular meeting of the Cincinnati Section

was held on Thursday, December 15th, in the Chemical Lecture Room of Hanna Hall, University Buildings, with fifteen members present and President O. W. Martin in the chair.

Prof. T. H. Norton read an interesting paper on the "Occurrence of the Diamond in Various Parts of the United States, and on the First Occurrence of the Diamond in Ohio." The exhibition of various specimens of diamonds, including that found in Ohio, and the experiment demonstrating the combustibility of this substance, lent additional interest to the paper. The gem found in Ohio presented in its cut state an unusual degree of brilliancy, while measurements of its specific gravity gave a result markedly higher than with any diamond hitherto observed, which would suggest a connection between its specific gravity and its refractive properties. This point Professor Norton intends further to investigate.

Mr. Willett C. Pierson then addressed the meeting on "The Mechanical and Chemical Testing of Cement," exhibiting specimens and charts illustrative of the subject.

The election of officers of the section for 1899 was finally held, and resulted as follows:

President—Wm. Simonson.
Vice-presidents—R. M. Hughes and J. N. Hurty.
Secretary—S. Waldbott.
Treasurer—Henry B. Foote.
Directors—Thomas Evans, D. J. Ogilvy, and Wm. H. Crane.

Upon motion the meeting adjourned.

S. WALDBOTT, *Secretary.*

CHICAGO SECTION.

The November meeting of the Chicago Section was held at the Technical Club, 230 South Clark Street, Tuesday, November 8th. After the usual dinner, Mr. Woods, of New York, described a process for extracting fats from tankage by means of light-boiling naphtha. This was followed by a general discussion of the subject.

F. B. Dains then read a paper on the preparation, properties, and reactions of the isourea ethers.

At the meeting of the Chicago Section held December 23d, the following officers were elected for the coming year:

President—C. E. Linebarger.
Vice-president—W. R. Smith.
Secretary—F. B. Dains.
Treasurer—C. W. Patterson.
Executive Committee—C. E. Linebarger, F. B. Dains, and E. K. Nelson.
Member of Council—J. H. Long.

F. B. DAINS, *Secretary.*

Issued with February Number, 1899.

Proceedings.

MINUTES OF THE EIGHTEENTH GENERAL MEETING OF THE AMERICAN CHEMICAL SOCIETY, HELD IN NEW YORK CITY, DECEMBER 27 AND 28, 1898.

TUESDAY MORNING, DECEMBER 27, 1898.

The morning session met in the Assembly Hall of the Chemists' Club, 108 W. 55th St., New York City. The meeting was called to order at 10.15 A.M., by Dr. William McMurtrie who welcomed the visiting chemists to the hospitalities of the New York Section.

Hon. Randolph Guggenheimer, president of the council of the City of New York, then welcomed the chemists to the City of New York, and President Alexander S. Webb, D.D., of the College of the City of New York, extended a special welcome on behalf of New York's educational and scientific institutions. In response, President Charles E. Munroe, of the American Chemical Society, thanked the previous speakers for the cordial welcome extended to the society, and expressed the appreciation of the members of the efforts in their behalf on the part of the New York Section.

President Munroe then called the meeting of the society to order at 10.30 A.M. On motion, M. T. Bogert was elected secretary *pro tem.*, on account of the illness of Secretary Hale. President Munroe then introduced Professor Raoul Pictet, of Geneva, who expressed his pleasure at being present, and spoke in eulogy of our country and of the work of our scientific men. Dr. McMurtrie moved "that the routine business of the society be postponed until the evening session and that we now proceed to the reading and discussion of papers." Seconded and carried.

The following is a list of the papers presented at the meeting of the society :

1. A New Method for the Separation of Arsenic, Antimony, Selenium, and Tellurium from One Another and from Other Metals. Augustus E. Knorr.

2. Measurement of Turbidity in Water. W. P. Mason.

3. Antitoxin Serum for Some Animal Diseases. E. A. de Schweinitz.

4. Separation of Impurities in the Electrolytic Refining of Copper. P. de P. Ricketts.

5. The Preparation of Metallic Tellurium. Victor Lenher.

6. The Preparation of Pure Tellurium. Henry Fay.

7. The Effect of Certain Nitrogenous Materials upon the Growth of Yeast. Harris E. Sawyer.

8. The Assay of Nux Vomica. E. R. Squibb.

9. The Potato and Cassava Starch Industries in the United States. H. W. Wiley.

10. Vanillin and Coumarin: Their Separation, Identification, and Estimation in Flavoring Extracts. (In abstract.) W. H. Hess and A. B. Prescott.

11. Emetine Octoiodide, and the Extraction and Estimation of Alkaloids generally. (In abstract.) H. M. Gordin and A. B. Prescott.

12. Notes on the Estimation of Carbohydrates. F. W. Traphagen and W. M. Cobleigh.

13. The Composition and Rancidity of Butter Fat. C. A. Browne, Jr.

14. The Action of Iodine on the Fatty Amines. James F. Norris.

15. On the Constitution of Some Canadian Baryto-celestites. C. W. Volney.

16. Laboratory Notes. A. C. Langmuir.

17. New Method for the Determination of Zinc. A. C. Langmuir.

18. Note on Drown's Method of Determining Silicon. A. C. Langmuir.

19. The Determination of Arsenic in Glycerine. A. C. Langmuir.

20. Note on Certain Flame Colorations Yielded by the Chlorides and Bromides of Nickel and Cobalt. Allerton S. Cushman.

21. Conservation of Energy in the Living Organism. W. O. Atwater.

22. Claissen's Reaction as an Aid to the Determination of the Constitution of Terpene Ketones. M. C. Burt.

23. The Determination of Sulphur in Sulphites. A. Bourgougnon.

24. Sixth Annual Report of the Committee on Atomic Weights. F. W. Clarke.

25. Report of the Third International Congress of Applied Chemistry. H. W. Wiley.

26. Improved Apparatus. J. L. Sammis.

27. The Determination of Potash as Perchlorate. F. S. Shiver.

28. Use of Compressed Oxygen in Elementary Organic Analysis; and of Soda-lime in the Quantitative Determination of Carbon Dioxide. F. G. Benedict and O. F. Tower.

29. Commercial Iron Silicides, with High Percentage of Silicon. G. de Chalmot.

30. Glycollic Acid: One of the Acids of Sugar Cane. Edmund C. Shorey.

31. The Analytical Constants of American Linseed Oil. Augustus H. Gill and Augustus C. Lamb.

32. A New Method for the Preparation of Cesium. Hugo Erdmann and A. E. Menke.

33. The Absorption of Methane and Ethane by Fuming Sulphuric Acid. R. A. Worstall.

34. Notes on the Rapid Determination of Tungsten in Steel. George Auchy.

35. The Determination of Carbon Monoxide, Methane, and Hydrogen by Combustion. L. M. Dennis and C. G. Hopkins.

36. Analytical Research on Sod Oil. Erastus Hopkins, D. L. Coburn, and Edward Spiller.

37. Table of Baumé's Hydrometer—American Standard. (By title.) Sidney S. Emery.

38. The Inversion of Sugar by Salts. (By title.) L. Kahlenberg, D. J. Davis, and R. E. Fowler.

39. The Heat of Bromination Tests for Oils. Augustus H. Gill and Israel Hatch, Jr.

40. A Balance for Use in Courses in Elementary Chemistry. C. E. Linebarger.

41. Sodium Aluminate as a Means for the Removal of Lime and Suspended Matter from Water for Use in Boilers. C. F. Mabery and E. R. Baltzley.

42. Perhalides of Quinoline. P. F. Trowbridge.

43. On The Isourea Ethers and Other Derivatives of Ureas. F. B. Dains.

44. The Action of Sulphuric Acid on Thymol. James H. Stebbins.

45. The Synthesis of Selenophen. Robert E. Lyons.

46. A New Filtering Medium. George W. Sargent and John Kirk Faust.

Papers 1, 4, and 5 were then read. In connection with the reading of his paper, Dr. Lenher exhibited a four-pound ingot of pure tellurium. A verbal abstract of paper 6 was given by Dr. Norris, and then followed a most interesting discussion, participated in by Messrs. Munroe, Mabery, Norris, Lenher, Ricketts, Knorr, and others, on the separation of selenium from tellurium and the preparation of pure tellurium, including methods for redetermining the atomic weight of tellurium. Paper 3 was read by title. Paper 2 was postponed (see minutes of Wednesday afternoon session).

The meeting adjourned at 11.45, in time to take a special train upon the Elevated R. R. at 12 o'clock, at the 58th St. Station. Crossing to Jersey City by the ferry at the foot of Liberty St., the society found a special train, provided by the Jersey Central R. R., to carry them to the New Jersey Zinc Co.'s works at Newark. After an excellent luncheon, generously provided by the latter company, the chemists inspected the works, every facility being afforded them by the officials of the

company. The remainder of the afternoon was spent in visiting the following places of interest, where the chemists met with a similar welcome and most courteous treatment: Balbach Smelting and Refining Co., P. Reilly Patent Leather Works, Murphy Varnish Co., Knickerbocker Cement Co., Wetherill Concentrator Co., and Benjamin Atha and Illingworth Steel Co. The special train left the New Jersey Zinc Co.'s works shortly after 5 P.M. on its return trip, over 150 chemists having taken part in the excursion.

EVENING SESSION, DECEMBER 27.

The evening session again met in the Assembly Hall of the Chemists' Club.

The meeting was called to order by President Munroe at 8.30 P.M. On motion the reading of the minutes of the last regular meeting was dispensed with.

Secretary Hale's report, which follows, was then read by the secretary *pro tem.*, and adopted:

REPORT OF THE SECRETARY.

The progress of the society continues unabated. The year 1898 has witnessed as great development along certain lines as any year in the history of the society. Radical changes have been made this year, and we may trust that in the main these changes have been marked improvements.

The constitution and by-laws recently adopted go into full effect at the beginning of 1899, and the year 1898 has marked the transition period between the old and the new.

The council has been very largely increased, and has become the governing body in all matters pertaining to the general welfare of the society. As now constituted, the council consists of the past presidents, 11 in number, 12 members elected at large, and one representative from each local section for every hundred members or fraction thereof, and in addition, the president, secretary, and editor *ex-officio*. There will be 42 councilors for the year 1899.

There has been a net gain in the membership during the past year of 259, a slightly larger increase than in any previous year in the history of the society, and nearly twice as much as the average gain since the year 1889, when the plan was formed to establish local sections and hold general meetings in different localities throughout the country. From that date the membership and influence of the society have steadily increased until

the present time, when the New York Section alone has about one-half more members than were registered on the whole roll of the society nine years ago.

The society has now ten local sections, the last one having been chartered during the present year. It is known as the North Eastern Section, and has its headquarters in Boston. The New Orleans Section, which has been reported in previous years, has been dissolved by act of the council, since it has never had more than a nominal existence.

By the courtesy of the Chemists' Club, of New York City, the library of the society has been furnished with permanent quarters, and an appropriation has been made by the council sufficient to furnish ample shelving. The resignation of the former librarian was accepted at the meeting of the council in Boston, last summer, and Mr. Marston Taylor Bogert was elected librarian in his place. The librarian is perfecting arrangements by which the advantages of the library may be enjoyed by members living at a distance, under suitable conditions regarding the safe transportation and return of the books.

The Committee on Standards of Measurement, recommended at the Washington meeting last winter, has been appointed, and will probably present a report at this meeting.

The edition of the Journal has been increased from 1,500 to 1,700, and with the present rapid growth in membership, a farther increase is likely to be demanded soon. The amount of material accepted by the Committee on Papers and Publications has accumulated so as to necessitate an increase in the size of the Journal during the present month, and it may be advisable to provide for a permanent increase in size.

The list of exchanges has been very thoroughly considered and revised by a committee appointed for that purpose. A committee has been appointed to consider the question of increasing the size of the Standing Committee on Papers and Publications. The chairman of the Committee on Water Analysis suggests that the committee be discharged, inasmuch as after considerable correspondence the members are unable to agree upon a report. The Committee on Duty-Free Importations made an exhaustive report some time ago, and this report is on file in the archives of the society.

The finances of the society have been in good condition, and under the authority of the directors a permanent investment of certain funds has been made by the treasurer, as will probably appear in his report. At the Boston meeting a committee was appointed by the council to consider the question of life memberships and the fund authorized by the constitution in connection therewith. This committee has reported to the council with a recommendation which has been adopted by that body,

authorizing the setting aside as a permanent "Life Membership Fund" sufficient to guarantee in perpetuity the interests of all present and past life members.

At the general meeting in Boston last summer, three additional honorary members were elected; *viz.*, Sir William Crookes, Henri Moissan, and J. H. van 't Hoff. These gentlemen have all accepted their election with expressions of profound thanks and appreciation of the same.

The membership of the society is now constituted as follows:

Honorary members	10
Members	1298
Associates	107
Total	1415

Since the presentation of the last annual report, the society has lost, by death, the following-named members:

Ferdinand von Mueller, Melbourne, Australia; S. W. McKeown, Youngstown, O.; Henry C. Coon, Alfred, N.Y.; Pedro J. Sosa, Panama, South America; Henry Trimble, Philadelphia; William Bromwell, Brooklyn, N. Y.; Thomas L. Blalock, Baltimore, Md.

Respectfully submitted,

ALBERT C. HALE,
Secretary.

The following report from the treasurer was presented and accepted:

REPORT OF THE TREASURER FROM DECEMBER 23, 1897, TO DECEMBER, 22, 1898.

REVENUE AND EXPENDITURES.

DR.

To Journal (12 Nos.)	$2,655.27
" Secretary's office	1,150.58
" Librarian's "	288.07
" Treasurer's "	101.47
" Editor's "	51.08
" " salary	250.00
" General expense	42.79
" Expenses of Washington meeting	144.17
" " Boston meeting	88.07
" Reprinting Journals	319.60
" Authors' reprints	176.89
" Review of American Chemical Research	47.75

To Local Sections:		
New York	$150.00	
Washington	158.67	
North Eastern	299.99	
Chicago	61.66	
Nebraska	10.36	
Columbus, O	11.66	
Cincinnati, O	68.23	
		$760.57
To Commissions to General Secretary		649.00
" Special investment fund		2,156.47
" Balance in bank		13.29
		$8,895.07

CR.

By Balance on hand December 23, 1897	$822.07
" Dues collected by General Secretary	6,490.00
" Subscriptions through Chemical Publishing Co	620.77
" Advertisements through Chemical Publishing Co	649.96
" Sales of back numbers through librarian	237.99
" Interest on balances	20.41
" " special investment	35.00
" Cash returned by Lehigh Valley Section	18.87
	$8,895.07

ASSETS AND LIABILITIES.

DR.

To Chemical Publishing Co	$63.70
" New York Local Section	28.84
" Columbus Local Section	3.84
" Rhode Island Local Section	0.59
" Balance in favor of American Chemical Society	4,012.05
	$4,109.02

CR.

By Special investment fund	$2,132.50
" Uncollected accounts (editor)	1,270.64
" " " (secretary)	615.00
" Balances in secretary's hands	77.59
" Cash in treasurer's hands	13.29
	$4,109.02

The library of the society does not appear in the above schedule of assets because it is not yet appraised. CHAS. F. MCKENNA, *Treasurer.*

The accounts of the treasurer, as set forth above, have been examined, together with the books, vouchers, and securities, and all have been found correct, E. & O. E.

A. H. SABIN,
DURAND WOODMAN,
A. P. HALLOCK,
Finance Committee.

NEW YORK, December 22, 1898.

The librarian's report was presented and accepted as follows :

REPORT OF THE LIBRARIAN.

To the Council of the American Chemical Society :

GENTLEMEN : I have the honor to report that I was elected librarian of the society on August 22, 1898, vice F. E. Dodge, resigned. The library of the society at that time was boxed up and in storage in New York City. The chief effort of the librarian has therefore been devoted to securing for the library a place where its volumes could be properly shelved and cared for, and where they should be accessible to all the membership upon demand in person or by letter. I am happy, therefore, to be able to report that the Board of Trustees of the Chemists' Club, at 108 West 55th St., New York City, have tendered to the American Chemical Society the use of their rooms as a depository for the library of the American Chemical Society, under the following general conditions :

(1) The books, pamphlets, periodicals, etc., to be shelved at the expense of the society, under the direction of the board of trustees of the club, the shelves and other library fixtures purchased by the society, to remain the property of the society.

(2) The society to assume the expense of the preservation and insurance of its library.

(3) That access to the library may be had by non-members of the club at such times as may be mutually agreed upon by the librarian of the society and the house and library committees of the club, subject to the approval of the board of trustees of the club.

In exercise of the power conferred upon it, the Library Committee of the society, consisting of the librarian, the chairman of the New York Section, and the treasurer, have agreed to the above general conditions, and the transfer of the library will begin as soon as the necessary shelving can be installed. A home is thus assured to the library of the society, where its volumes can be carefully distributed and classified. As soon as this is accomplished, the books will be carefully catalogued, and copies of this catalogue forwarded to all the members, indicating also under what conditions books can be withdrawn from the library. It is believed that then the society will appreciate the value of having such a library, that all the membership may enjoy its benefits, and that they will take pride in keeping it thoroughly up to date, which is the *sine qua non* of a scientific library.

Respectfully submitted,

MARSTON TAYLOR BOGERT,
Librarian.

The report of the Committee on Coal Analysis was presented by Dr. McMurtrie for the committee. On motion, the report was accepted and the committee continued.

The Committee on Standard Color for Water Analysis reported their failure to agree upon any standard. The report was accepted and the committee discharged.

The report of the Committee on Atomic Weights was presented as paper No. 24 (see minutes of Wednesday morning session), to be read on Wednesday.

The report of the Committee on Standards for Instruments of Measure, was presented, and, on motion, referred to the council for action.

The report of the Committee on Nomenclature and Spelling of the Journal was presented by Dr. Hart, with the recommendation that the component elements of didymium be termed praseodymium and neodymium, instead of praseodidymium, etc. The report was accepted and the recommendation referred to the council for action.

The report of the Committee on Enlarging the Committee on Papers and Publications was presented, accepted, and referred to the council for action.

Major C. C. Parsons presented a resolution calling for the appointment of a Committee on Patents and Patent Legislation. On motion, the matter was referred to the council for action.

President Munroe then announced the result of the voting for president and councilors of the society for the coming year as follows:

President—Edward W. Morley.

Councilors for Three Years—Ira Remsen, Arthur A. Noyes, Thomas M. Drown, William McMurtrie.

Councilors for Two Years—F. A. Gooch, William A. Noyes, H. L. Wells, A. A. Breneman.

Councilors for One Year—F. W. Clarke, S. P. Sadtler, C. F. Mabery, Durand Woodman.

Prof. Raoul Pictet was next introduced and delivered a most interesting lecture upon "La suppression des phénomènes chimiques a basse température," illustrating his remarks by experiments and the lantern. He showed that hydrochloric acid, which has been cooled down by a mixture of solid carbon

dioxide and ether, has no action whatever upon metallic sodium; and he also traced the relation existing between the forces controlling the atoms from astronomical, physical, and chemical points of view.

Professor Pictet was followed by President Munroe, who chose as the subject of his address, "Explosions Caused by Commonly Occurring Substances." President Munroe dwelt especially upon the recent explosion in the National Capitol at Washington, and exhibited a large number of interesting lantern slides and plans in explanation of the same.

The meeting adjourned at 11.25 P.M.

WEDNESDAY MORNING, DECEMBER 28.

The Wednesday morning session met in Havemeyer Hall of Columbia University, New York City.

The meeting was called to order by President Munroe at 10.30 A.M. President Seth Low, of Columbia University, welcomed the visiting chemists to Columbia, and Chas. F. Chandler, professor of chemistry, welcomed them to Havemeyer Hall, the chemical building of the university. Professor Chandler, in the course of his address, sketched the development of chemistry at Columbia, from the founding of the School of Mines to the present time.

The reading of papers was then taken up. Papers 7, 10, and 11, were read by title, and Dr. Wiley presented a short verbal abstract of his paper (No. 9). Paper 12 was read, and in the discussion which followed, Dr. Wiley stated that the determination of starch was still among the most difficult in analytical chemistry, the trouble being that most starches were not simple substances but usually mixtures, the character of the mixture varying according to the source from which the starch was obtained. Further, the separation of starch is by no means an easy task; ferments do not attack all starches at the same rate, nor does inversion proceed at the same rate with all starches. The chemistry of starch is still very little understood.

Papers 14 and 15 were read by their respective authors; paper 13 by title. Papers 16, 17, 18, and 19, were read by Dr. Langmuir. Paper 8 was read by Dr. Squibb. Papers 21 and 23 were read by title. Paper 24 was presented by Professor

Clarke, and Dr. McMurtrie moved "that a committee of five members of the society be appointed to confer with similar committees of other chemical societies of the world, with the object of securing uniformity in conclusions regarding atomic weights." The motion was carried. The president appointed, as such International Committee on Atomic Weights, the following members; F. W. Clarke, *Chairman*, E. W. Morley, Edgar F. Smith, J. W. Mallet, and T. W. Richards.

On motion of Dr. Wiley, the society extended a hearty vote of thanks to the following: Chemists' Club, New York Section, Columbia University, Seth Low, C. F. Chandler, Raoul Pictet, President Munroe, Messrs. Guggenheimer and Webb, N. J. Central R. R., N. J. Zinc Co., Messrs. McMurtrie, Doremus, Tripler, the Press, College of the City of New York, *Brooklyn Daily Eagle*.

Dr. Whitney moved "that all remaining papers be read by abstract." The motion was lost.

On motion, all who had brought apparatus to illustrate their papers were invited to place the same on exhibition upon the lecture table.

The meeting adjourned at 1.10 P.M., to the Industrial Laboratory of Havemeyer Hall, where a lunch was provided by the New York Section.

WEDNESDAY AFTERNOON, DECEMBER 28.

The concluding session was held in Havemeyer Hall, of Columbia University.

The meeting was called to order by President Munroe at 2.34 P.M., when the reading of papers was resumed. Papers 2, 20, and 22 were read by their respective authors. Paper 25 and all the remainder on the programme, were read by title, none of the authors being present. Dr. Hart read a communication from Prof. Norton concerning diamonds found recently in the vicinity of Cincinnati, Ohio.

The meeting then adjourned, *sine die*, at 3.25 P.M.

At 5 o'clock in the afternoon the members were welcomed to the College of the City of New York, by Professor R. O. Doremus, and were entertained by a lecture and demonstration of the properties of liquid air by Charles E. Tripler, which was very largely attended.

In the evening a complimentary dinner was given to the visiting members by the New York Section, at the Waldorf-Astoria. About 150 chemists were present. The toasts and speakers were as follows: "The Past Year," Dr. C. E. Munroe; "The Coming Year," Dr. E. W. Morley; "Our Higher Education," Dr. Seth Low; "Our Allied Science," Mr. Gano S. Dunn; "Our Guests," Dr. H. W. Wiley; "Our Friends across the Sea," Prof. Raoul Pictet; "Our Past Presidents," Dr. C. F. Chandler; "Our Science Applied," Mr. W. H. Nichols; "Our Science Taught," Prof. J. H. Appleton; "Our Absent Friends," Dr. W. P. Mason.

M. T. BOGERT, Sec'y *pro tem.*

BOARD OF DIRECTORS.

The board of directors of the American Chemical Society met on Wednesday, December 28, 1898, at the Chemists' Club. The meeting was called to order by President Munroe, at 1.23 A.M., the following directors being present: Munroe, Doremus, McMurtrie, and Chandler. M. T. Bogert was appointed secretary *pro tem.*

It was moved "that all expenditures since the Boston meeting, up to and including the present meeting, be and are hereby authorized." The motion was carried.

The meeting adjourned at 1.25 A.M.

M. T. BOGERT, Sec'y *pro tem.*

COUNCIL.

The council of the American Chemical Society met on Tuesday, December 27, 1898, at the Chemists' Club. The meeting was called to order by President Munroe at 11.35 P.M., the following councilors being present: Wiley, Doremus, Austen, McKenna, Hart, Mabery, McMurtrie, Chandler, Breneman, Clarke, and Bogert. On account of the illness of Secretary Hale, M. T. Bogert was appointed secretary *pro tem.*

Dr. McMurtrie gave notice of some proposed amendments to the constitution of the society, which had received the signatures of the requisite five members of the council, and asked for the appointment of a committee to consider the same and report

thereon to the council within three months from date. The president appointed, as such committee, Messrs. McMurtrie, Breneman, and Wiley.

On motion, the secretary was directed to take the usual mode of procedure in the matter of selecting the various officers and committees to be chosen by the council for the year 1899. Dr. Wiley was appointed by the council to move the thanks of the society to the New York Section, etc., at the closing session of the meeting.

The following motions were duly made, seconded, and carried:

(1) That all nominations to membership up to the close of the present meeting, shall be considered passed upon favorably by the council whenever they shall be favorably reported by the committee and published in the Journal.

(2) That the secretary be and is hereby authorized to expend an amount not exceeding $100.00 for typewriter or other material to save time and labor in his official work.

(3) That the council hereby suggests and recommends that hereafter the customary dinner at the general meetings of the society be a subscription dinner, and not a complimentary one at the expense of the local section.

(4) That, hereafter, the editor be allowed to retain ten copies of each number of the Journal when published for editorial use.

(5) That the Eighteenth General Meeting of the society shall close on Wednesday, December 28, 1898, and shall not continue on Thursday, December 29, 1898, as suggested.

(6) That, beginning with the February number, the edition of the Journal of the society shall be increased from 1,700 copies to 2,000 copies.

(7) That the Committee on Papers and Publications be authorized to increase the size of the Journal to 125 pages, for the next three numbers.

(8) That a committee be appointed to adjust the matter of foreign postage with the editor, said committee to report to the council, and then to the board of directors; McMurtrie, C. B. Dudley, and McKenna were appointed as such committee.

Dr. Hart read letters from Drs. Trevor and Norton, relating to the publication of papers on physical chemistry in the *Journal of Physical Chemistry*. On motion, it was resolved "that, whereas

the American Chemical Society now has a Journal in which similar articles can be published, the council deem it inexpedient to adopt, as its official organ, any other publication."

The following was received from Major C. C. Parsons:

"Whereas, a special committee appointed by the president is now considering changes in the Patent Law—and, whereas, a number of bills are now pending in Congress, many of which are hostile to the interests of chemical industries, Resolved that this committee be authorized to request the Congressional Committee to defer action for the present, and it is recommended by this committee that a permanent committee be appointed by the American Chemical Society on patent and related legislation."

The council thereupon voted "that a Committee on Patent and Related Legislation, to consist of twenty-five members of the society, be appointed by the president of the society, President Chas. E. Munroe to be the chairman of said committee."

The recommendation of the Committee on Nomenclature and Spelling of the Journal in regard to the words praseodymium and neodymium was adopted (see minutes of the society for the Tuesday evening session). It was moved "that the chairman appoint a committee of not less than five members of the society, to attend the Pure Food Congress in Washington, D. C., January 18, 1899, as the delegates of the American Chemical Society." The motion was seconded and carried. Munroe, McMurtrie, Little, of Boston, Appleton, of Providence, and Simon, of Baltimore, were appointed as such committee.

Dr. McMurtrie moved the thanks of the council to Dr. Munroe for his able and successful administration of the business of the society. The motion was carried unanimously.

The meeting adjourned at 1.20 A.M.

The council of the American Chemical Society met on Wednesday, December 28, 1898, at Columbia University. The meeting was called to order by President Munroe, at 3.30 P.M., the following councilors being present: Hart, McMurtrie, Wells, Noyes, Chandler, Clarke, Barker, and Bogert.

It was moved "that the Committee on Papers and Publications be and are hereby authorized to publish a portrait of the

retiring president of the society in the same number of the Journal in which the presidential address is published." The motion was carried.

Dr. Noyes reported for the Committee on enlarging the standing Committee on Papers and Publications.

The report of the committee was accepted and numbers 1, 3, 4, 5, and 6 were adopted as follows:

1. That the Committee on Papers and Publications shall consist of eleven members so chosen as to include, in addition to the editor, representatives of each of the more important divisions of chemistry.

3. That no specific divisions of the subject be announced in the publication of the committee.

4. That after the committee shall have been reorganized, each and every paper submitted for publication by the society, shall be referred by the editor to that member of the committee to whose department the paper in question belongs, who shall, jointly with the editor, decide finally in regard to its publication; provided, that in case of disagreement between the editor and said member, the paper shall be submitted to the president of the society for his decision.

5. That in all matters other than the acceptance of papers for publication, the committee shall act as a whole, the editor acting as chairman and secretary.

6. That the reorganized committee shall take office on January 1, 1899, or as soon thereafter as is possible.

Recommendation No. 2 was not adopted, but it was decided to submit it to the whole (new) council by correspondence, asking first for additional nominations from the councilors, and then, after these are received, submitting the matter to ballot, directing each councilor to vote for *one name* under each division of chemistry.

M. T. BOGERT, *Secretary pro tem.*

COUNCIL OF THE AMERICAN CHEMICAL SOCIETY, JAN. 1, 1899.

Members ex-officio.

Edward W. Morley, president, Adelbert College, Cleveland, O.
Albert C. Hale, secretary, 551 Putnam Ave., Brooklyn, N. Y.
Edward Hart, editor, Easton, Pa.

The Past Presidents.

Dr. S. W. Johnson,	54 Trumbull St., New Haven, Conn.
Charles F. Chandler,	Columbia University, N. Y. City.
J. W. Mallet,	Univ. of Virginia, Charlottesville, Va.
Albert B. Prescott,	Univ. of Michigan, Ann Arbor, Mich.
C. A. Goessmann,	Amherst, Mass.
George F. Barker,	3909 Locust St., Philadelphia, Pa.
G. C. Caldwell,	Cornell University, Ithaca, N. Y.
H. W. Wiley,	U. S. Dept. of Agriculture, Washington.
Edgar F. Smith,	Univ. of Pennsylvania, Philadelphia, Pa.
Charles B. Dudley,	Drawer 334, Altoona, Pa.
Charles E. Munroe,	Columbian University, Washington, D. C.

By Special Article of New Constitution, until December, 1899.

Peter T. Austen,	346 Broadway, N. Y. City.

Councilors at Large. Term expires December, 1899.

F. W. Clarke,	U. S. Geological Survey, Washington, D.C.
Charles F. Mabery,	Case School of Applied Science, Cleveland, O
Samuel P. Sadtler,	1042 Drexel Building, Philadelphia, Pa.
Durand Woodman,	127 Pearl St., N. Y. City.

Term expires December, 1900.

A. A. Breneman,	97 Water St., N. Y. City.
F. A. Gooch,	Yale University, New Haven, Conn.
William A. Noyes,	Rose Poly. Inst., Terre Haute, Ind.
Horace L. Wells,	57 Trumbull St., New Haven, Conn.

Term expires December, 1901.

Thomas M. Drown,	Lehigh University, So. Bethlehem, Pa.
William McMurtrie,	101 W. 81st St., N. Y. City.
Arthur A. Noyes,	Mass. Inst. Technology, Boston, Mass.
Ira Remsen,	Johns Hopkins University, Baltimore, Md.

Councilors from Local Sections. Rhode Island Section.

Charles A. Catlin,	133 Hope St., Providence, R. I.

Cincinnati Section.

Alfred Springer,	P. O. Box 621, Cincinnati, O.

New York Section.

Charles A. Doremus,	17 Lexington Ave., N. Y. City.
J. B. F. Herreshoff,	19 Pierrepont St., Brooklyn, N. Y.
E. G. Love,	80 E. 55th St., N. Y. City.
A. H. Sabin,	Box 85, Long Island City, N. Y.

Washington Section.

W. F. Hillebrand,	U. S. Geological Survey, Washington, D. C.

Lehigh Valley Section.

Porter W. Shimer,	Easton, Pa.

Chicago Section.

John H. Long,	2421 Dearborn St., Chicago, Ill.

Nebraska Section.

H. H. Nicholson,	Univ. of Nebraska, Lincoln, Nebraska.

North Carolina Section.

Charles Baskerville,	Chapel Hill, N. C.

Columbus Section.

N. W. Lord,	Ohio State University, Columbus, O.

North Eastern Section.

John Alden,	Lawrence, Mass.
A. D. Little,	7 Exchange Place, Boston, Mass.
Henry P. Talbot,	Mass. Inst. Technology, Boston, Mass.

NAMES PROPOSED FOR MEMBERSHIP.

Banghart, Edgar D., Wymore, Nebraska.
Baxter, Wm. T., 47 St. Felix St., Brooklyn, N. Y.
Bradbury, Dr. Robert H., Central Manual Training School, Philadelphia.
Hamilton, H. C., 637 Baker St., Detroit, Mich.
Hazard, F. R., Solvay Process Co., Syracuse, N. Y.
Hoffman, John W., State A. and M. College, Orangeburg, S.C.
Horton, E. G., Lab. State Board of Health, Columbus, O.
Koch, Charles F., 2334 Ashland Ave., Cincinnati, O.
Lamar, Wm. R., 55 W. 127th St., N. Y. City.
Lamborn, Leebert L., care of Curtis Davis & Co., 136 State St., Boston, Mass.
Lee, Waldemar, 2802 W. Lehigh Ave., Philadelphia.
Linton, J. H., 3012 Wabash Ave., Chicago, Ill.
McCay, Leroy W., Princeton, N. J.
Neiman, Howard S., 8 E. 97th St., N. Y. City.
Rogers, Allen, Univ. of Maine, Orono, Me.
Schober, W. B., Lehigh Univ., South Bethlehem, Pa.
Spieler, Augustus J., care of The Will and Baumer Co., Syracuse, N. Y.
Street, John Phillips, New Brunswick, N. J.
Wagner, Dr. Theodore B., care of Glucose Sugar Ref. Co., Beach & Taylor Sts., Chicago, Ill.
Wiener, William, 62½ Nelson Place, Newark, N. J.
Wilkens, H. A. J., care of N. J. Zinc Co., 52 Wall St., N. Y. City.
Witherspoon, Thomas A., 27 Iowa Circle, Washington, D.C.

NAMES PROPOSED FOR ASSOCIATE MEMBERSHIP.

Cayvan, Llewellyn L., 660 Sixth St., South Boston, Mass.
Driehaus, Irwin W., Madisonville, O.
Fetsch, William, 2530 W. 6th St., Cincinnati, O.
Russell, George F., care of Russell Paper Co., Lawrence, Mass.
Young, Charlotte S., Mt. Hope Road, Price Hill, Cincinnati, O.

NEW MEMBERS ELECTED JANUARY 23, 1899.

Barnett, Edwin S., Mt. Alvern, Delaware Co., Pa.
Bassé, Karl Kurt, 158 Waverly Place, N. Y. City.

Bradley, Walter Parke, 242 High St., Middletown, Conn.
Brush, Charles F., 1003 Euclid Ave., Cleveland, O.
Closson, C. D., Ohio Med. Univ., Columbus, O.
Coggeshall, George W., 13 Prescott Hall, Cambridge, Mass.
Cook, Robert A., 66 Maiden Lane, N. Y. City.
Crane, Fred., 142 Walnut St., Montclair, N. J.
Dieckmann, Otto, 1182 Harrison Ave., Cincinnati, O.
Gallivan, Frank B., Polytechnic Institute, Brooklyn, N. Y.
Giddings, H. DeWitt, 173 Loomis St., Burlington, Vt.
Gruener, Hippolyte, Adelbert College, Cleveland, O.
Haigh, Frederic, 677 E. 24th St., Paterson, N. J.
Harris, Isham G., M.D., State Hospital, Poughkeepsie, N. Y.
Hesse, Bernard Conrad, 128 Duane St., N. Y. City.
Hiltner, Martin E., 1301 N. St., Lincoln, Nebr.
Kelly, Daniel J., M.D., U. S. Patent Office, Washington, D. C.
Levene, Phoebus A., 1626 Madison Ave., N. Y. City.
Levison, W. Goold, Cooper Institute, N. Y. City.
Riddle, Robert N., Uwchland, Chester Co., Pa.
Sadtler, Samuel S., 235 Jefferson Ave., Brooklyn, N. Y.
Schuyler, Erwin H., Watertown High School, Watertown, N.Y.
Sovereign, Clarence L., 128 N. Winnebago St., Rockford, Ill.
Thatcher, Roscoe W., Beatrice High School, Beatrice, Nebr.
Thompson, Milton S., P. O. Box 1, Newburyport, Mass.
von Egloffstein, Camill, 714 Bushwick Ave., Brooklyn, N. Y.
Welt, Ida, Ph.D., 314 Lexington Ave., N. Y. City.
Wolff, Frank A., U. S. Coast and Geodetic Survey, Washington, D. C.

ASSOCIATES ELECTED JANUARY 23, 1899.

Becket, Frederick M., 310 W. 122nd St., N. Y. City.
Caldwell, John A., Jr., Cornell University, Ithaca, N. Y.
Duff, William A., 310 W. 122nd St., N. Y. City.
Hall, Gaylord C., P.O. Box 506, Central Univ., Richmond, Ky.
Hoeppner, Josephine M., Pullman, Wash.
Kinsley, William J., 202 Broadway, N. Y. City.
Loeser, Robert M., Stanford University, Cal.
Lysle, Walter S., 223 Chartiers St., Allegheny, Pa.
Macdonald, N. M., Everett, Mass.
Meader, Arthur L., Norwood, Cincinnati, O.
Parker, Samuel C., 4263 Fergus St., Cincinnati, O.
Porter, John J., Station C, Cincinnati, O.
Robeson, Anthony N., The Gracemore, 120th St. and Morningside Ave., N. Y. City.
Roller, Henry C., Cranford, N. J.

CHANGES OF ADDRESS.

Lindauer, Arthur M., 302 N. State St., Ann Arbor, Mich.
Passolt, H. A., LaSalle, Ill.

Persons, A. A., University, Ala.
Pickel, J. M., West Raleigh, N. C.
Root, William L., 11 Church St., Pittsfield, Mass.

MEETINGS OF THE SECTIONS.

CINCINNATI SECTION.

The sixty-fifth regular meeting of the Cincinnati Section took place on Monday, January 16th, in the Chemical Lecture Room of Hanna Hall, University Buildings, with twenty-three members in attendance and about fifty persons present in all, President Wm. Simonson in the chair.

Dr. Wm. Groff, upon request, entertained the meeting by relating his observations on the zodiacal light in the Egyptian desert, and its bearing upon the religious rites of the Mahomedans in that region.

Prof. J. Warren Ritchey then gave an interesting account of the construction of a reflecting telescope, five feet in diameter, now being built at the Yerkes observatory in Wisconsin, and particularly designed for the purposes of photographic and spectroscopic work. The reading of the paper was well illustrated by diagrams and concluded with an exhibition of a number of rare lantern slide views, furnished through the courtesy of the speaker's brother, Mr. Willis Ritchey, the optician in charge at the Yerkes observatory, who has devised the special features of the telescope under consideration.

S. WALDBOTT, *Secretary.*

LEHIGH VALLEY SECTION.

A regular meeting of the Lehigh Valley Section was held in the Chemical Laboratory of Lafayette College, at Easton, on Thursday evening, January 19th, Dr. Joseph W. Richards presiding.

The annual report of the treasurer was read and approved.

Mr. Porter W. Shimer read a paper on "Silica and the Insoluble Residue in Cement." He compared the hydrochloric acid method with the fusion method for determining silica, and showed that, while in a great many instances the results obtained did not vary more than two-tenths per cent., he had analyzed several cements in which the hydrochloric acid method, the method commonly employed by cement chemists, gave results much too high. Four recent samples showed a difference in the percentage of

silica obtained by the two methods of 2.48 per cent., 2.46 per cent., 1.1 per cent., and 1.0 per cent., respectively, in each case the silica obtained by the direct acid treatment being high. A subsequent complete analysis of the filtrate from the high silica of the first sample gave correspondingly low results for the other determinations, the alumina being low by 1.24 per cent., iron oxide by 0.64 per cent., lime by 0.28 per cent., magnesia by 0.12 per cent., and sulphuric anhydride by 0.14 per cent., a total low percentage of 2.42.

In another sample he obtained 26.9 per cent. silica by the fusion method, and 31.45 per cent. by the acid method, showing the extraordinary difference of 4.55 per cent. The physical tests of the cements showing these high differences indicated marked inferiority.

The paper was discussed by Messrs. Buck, Hart, Louder, and others.

Dr. Joseph W. Richards presented papers on "A Portable Specific Gravity Apparatus," and on "A New Form of Button Scale for Use in Quantitative Blowpipe Analysis." Dr. Richards traced the development of each apparatus from its earliest form and exhibited the latest products of his researches. The new specific gravity apparatus has an accuracy of 0.1 to 0.2, is of a convenient form for transportation, and can be used also as a hydrometer for liquids a little lighter or a little heavier than water. The button scale which Dr. Richards had made in accordance with his latest ideas is far in advance of the older forms in point of accuracy, and has a distinct advantage in the very small liability to get out of order.

The papers were discussed by Messrs. Shimer, Ullman and Hart.

Mr. Richard K. Meade exhibited an ingenious form of apparatus for the violent agitation of solutions during the passage of hydrogen sulphide or other gases.

On motion, the meeting adjourned.

BERNARD ENRIGHT, *Secretary.*

NOTICE.

Hereafter the regular monthly meetings of the New York Section will be held in the Assembly Hall of the Chemists' Club, 108 W. 55th Street, and the dates will be March 10, April 7, May 5, and June 9. All chemists are invited to attend.

Issued with March Number, 1899.

Proceedings.

COUNCIL.

The following Committee on Patent and Related Legislation has been appointed, in accordance with the vote of the Council at the New York Meeting:

Charles E. Munroe, Washington, D. C., *Chairman.*
C. Chauncey Parsons, Brooklyn, N. Y., *Secretary.*
William McMurtrie, N. Y. City.
Durand Woodman, N. Y. City.
W. H. Nichols, N. Y. City.
T. B. Stearns, Jersey City, N. J.
E. G. Love, N. Y. City.
A. D. Little, Boston, Mass.
S. P. Sharples, Boston, Mass.
S. P. Sadtler, Philadelphia.
A. M. Todd, Kalamazoo, Mich.
Henry Carmichael, Boston, Mass.
William Hoskins, Chicago, Ill.
W. B. Rising, Berkeley, Cal.
E. D. Pearce, Providence, R. I.
Joseph W. Richards, Bethlehem, Pa.
J. T. McGill, Nashville, Tenn.
N. P. Hill, Denver, Colo.
H. B. Hodges, Long Island City, N. Y.
William P. Mason, Troy, N. Y.
L. P. Kinnicutt, Worcester, Mass.
S. A. Lattimore, Rochester, N. Y.
C. H. Herty, Athens, Ga.
J. L. Fuelling, Chicago, Ill.
Isaac Adams, Annisquam, Mass.

NAMES PROPOSED FOR MEMBERSHIP.

Alway, F. J., Wesleyan Univ., University Place, Nebr.
Atkinson, J. W., Santa Maria, Cal.
Bigelow, Henry W., care of Pope Mfg. Co., Hartford, Conn.
Bigelow, Samuel L., Univ. of Mich., Ann Arbor, Mich.
Curtis, Marvin, 123 California St., San Francisco, Cal.
Divine, Robert E., 75 Niagara St., Buffalo, N. Y.

Goldstein, Harris, 15 Montgomery St., Manhattan, N.Y. City.
Greenberg, Benjamin C., 67 E. 3d St., N. Y. City.
Gross, Abraham, Duquesne Chem. Lab., Duquesne, Pa.
Hartzell, Harry S., 22 N. 8th St., Allentown, Pa.
Haskins, Henri D., Amherst, Mass.
Haywood, W. G., State Chemist's Office, Raleigh, N. C.
Hess, William H., 721 E. Huron St., Ann Arbor, Mich.
Kelly, F. G., State Chemist's Office, Raleigh, N. C.
Kumler, Albert A., Odd Fellows' Temple, 7th and Elm Sts., Cincinnati, Ohio.
Priest, George W., Watertown, Mass.
Ragland, Chas. D., Ashland, Va.
Shaw, H. I., Gilt Edge, Mont.
Snyder, Oscar J., Room 23, Y. M. C. A. Building, Minneapolis, Minn.
Stephens, W. B., Care Stephens & Bro., Marshall Ave., Cincinnati, O.
Turnbull, Davis F., 34 India St., Boston, Mass.
Tutwiler, Carrington C., 14 Bank St., Philadelphia, Pa.
Van Dyck, Edwin M., 4 Iowa Circle, Washington, D. C.
Wiechmann, F. G., 771 West End Ave., Manhattan, New York City.

NAMES PROPOSED FOR ASSOCIATE MEMBERSHIP.

Bates, Hugh H., 502 E. 3d St., Cincinnati, O.
Edgar, Wm. H., 29 Rialto Bldg., Chicago, Ill.
Fry, Harry S., Pleasant Ridge, Cincinnati, O.
Keiser, Miss Marshall, Hotel Avenel, Fort Thomas, Ky.
Kendall, Arthur I., 338 Broadway, Somerville, Mass.

CHANGES OF ADDRESS.

Barlow, W. H., Pasadena, Cal.
Brackett, E. R., 47 Jackson St., Lawrence, Mass.
Busby, Fred. E., Adams, Mass.
Cambier, Jacob, 910 Spruce St., Pueblo, Colo.
Cook, A. D., State Agr. Expt. Sta., Geneva, N. Y.
Crumbie, W. D., 146 Washington St., E. Orange, N. J.
Dortch, Fred W., Scott, Ark.
Doscher, Henry, 122 E. 37th St., N. Y. City.
Fuller, Geo. W., Court and Martin Sts., Cincinnati, Ohio.
Hayes-Campbell, J., Care Amer. Pipe & Foundry Co., Bessemer, Ala.
Johnson, Geo. A., Court and Martin Sts., Cincinnati, Ohio.
Lippincott, Warren B., Care C. K. C. S. & R. Co., Argentine, Kan.
Pickel, J. M., West Raleigh, N. C.

Pope, C. W., Room 14, 220 Devonshire St., Boston, Mass.
Starke, F. W., 1853 N. 28th St., Philadelphia, Pa.
Stebbins, J. H., Jr., 80 Madison Ave., N. Y. City.
Trubek, M., 26 E. 104th St., N. Y. City.
Wallenstein, Florian, Oranienburgerstrasse 28, Berlin N, Germany.
Waller, Elwyn, 159 Front St., N. Y. City.

MEETINGS OF THE SECTIONS.

CHICAGO SECTION.

The January meeting of the Chicago Section was held at the Technical Club, Thursday, the 26th. After the usual dinner, Professor Felix Lengfeld, of the University of Chicago, presented a very interesting paper on "Some Recent Problems of Inorganic Chemistry." He gave a sketch of recent investigations along, and opportunities for research in, such lines as the new elements, carbides, nitrides and other derivatives of nitrogen, hydrides, the nature of oxidation, alloys, the precipitation of metals by metals, etc.

Dr. J. H. Long followed with an account of the winter meeting of the American Chemical Society in New York.

F. B. DAINS, *Secretary.*

WASHINGTON SECTION.

The regular meeting of the Washington Section was held on January 12, 1899.

The first paper of the evening was read by Dr. E. A. deSchweinitz, and was entitled "The Serum Treatment of Some Animal Diseases."

In this paper the author gave a general review of the work begun in 1890 in the study of the substances secreted by the hog cholera and the swine plague germ in relation to immunity. He further pointed out the production of an enzyme by the hog cholera and other allied germs, and their importance in producing, in animals, immunity to disease. From this point the work was extended to a study of the serum obtained from animals that had been immunized to disease, and this was found to contain an immunizing principle and exerted curative properties upon experimental animals affected with hog cholera and swine

plague, respectively. Following these experiments, practical work has been carried out in the field for several years, with very satisfactory results. The treatment with serum was found to save about eighty per cent. of infected herds, while in those herds not treated which served as checks the loss from disease was over eighty per cent.

In practical work in the field it is difficult to decide often, whether the animals are suffering from either hog cholera or swine plague alone, or both of these diseases. To overcome this difficulty it has appeared advisable to use a curative serum for one of these diseases mixed with a curative serum for the other. For protective vaccination it appears advisable to use in addition to the serum, the products of the bacteria as well as their cell contents, including the products of the secretion or excretion.

The second paper of the evening was read by Dr. F. K. Cameron, and was entitled, "On the Estimation of Nicotine," by E. A. de Schweinitz, J. A. Emory, and F. K. Cameron.

This paper described a critical examination of the analytical methods so far proposed, and with special reference to the so-called "Kissling method." Attempts to devise a satisfactory method were made, by the formation of double salts with metallic compounds; precipitation of an addition compound with bromine or iodine; precipitation with picric acid; precipitation with phosphomolybdic or phosphotungstic acid; decomposition of accompanying amines by nitrous acid; decomposition of these compounds with hypochlorous or hypobromous acid; separation of the ammonia as oxalate by addition of alcohol. The results were summed up as follows:

I. The so-called "Kissling method" was to be regarded as the best so far proposed. For the estimation of nicotine in tobacco leaves or powders it may be regarded as satisfactory, but its application to tobacco extracts yields very unreliable results.

II. A complete extraction of nicotine by ether and some other solvents is readily accomplished.

III. An evaporation of an ether extract will afford a practicable separation from ammonia alone, but not from other organic bases.

IV. A complete separation by distillation with steam, is much more difficult than is usually supposed. Certain deviations from the usual practice were suggested.

V. No method involving the precipitation of the nicotine in an insoluble compound has been found practicable.

VI. No method involving the decomposition of accompanying compounds has been found practicable.

VII. The presence of tertiary amines, and probably some pyridine derivatives in tobacco extracts, is as yet an insurmountable obstacle in the separation or estimation of nicotine.

Finally it is to be observed that nicotine does not yield a nitroso-compound. It comports itself as a tertiary amine. Its separation from ammonia, primary and secondary amines, can be more or less readily accomplished by the adaptation of well-known general methods. Its separation from tertiary bases must be dependent on the discovery of some accidental physical or chemical property of the substances involved, which cannot be predicated from known general principles. It would seem that a satisfactory solution of the problem is dependent on some possible empirical relation, and it is in this direction that further investigation is indicated; but it is to be hoped that a more profound study of nicotine itself will yield satisfactory evidence as to its true nature, and from the knowledge thus gained, the problem before the analyst may not be so aimless or complicated as it now seems.

WILLIAM H. KRUG, *Secretary.*

NEW YORK SECTION.

The January meeting of the New York Section of the American Chemical Society was held on Friday evening, the 13th, in the Assembly Hall of the Chemists' Club, 108 West 55th street, Dr. William McMurtrie presiding.

An arrangement for holding the meetings of the society regularly in the club building was announced and ratified by unanimous vote. Reports were made showing that the funds contributed for the expenses of the midwinter meeting had been sufficient; that the library had been moved to the club-rooms, where it was undergoing classification and arrangement, and that the resident membership had reached 100, and the non-resident nearly, if not quite, as many more.

The following papers were read: "Determination of the Bromine Absorption of Fats," by P. C. McIlhiney; "Indicators," by John Waddell; "Exhibition of Apparatus for Washing Precipitates, etc.," by W. D. Horne.

Mr. McIlhiney recommends the bromine number instead of the iodine number for identifying oils and fats, on account of the greater rapidity of reaction, greater stability of the bromine-carbon-tetrachloride solution, both before and during use, and the want of differentiation by iodine between addition and substitution compounds in the reaction.

Mr. Waddell showed some very pretty experiments, illustrating the behavior of indicators, and explanatory of their adaptability to acid or alkaline reaction, according to their respective constitution.

Phenolphthalein, a weak acid, reacts red by dissociation in presence of a strong alkali; in presence of ammonia and alcohol the reaction may be restrained and again developed by addition of water. Methyl orange, cyanine, and corralline were similarly demonstrated.

A letter was read from the general secretary stating that "at the closing session of the midwinter meeting at Columbia University, December 28, by unanimous vote, the cordial thanks of the Society were extended to the New York Section for the bountiful hospitalities of the section, which were so heartily enjoyed by the members of the society during the eighteenth general meeting.

DURAND WOODMAN, *Secretary.*

The February meeting was held in the Assembly Room of the Chemists' Club, 108 West 55th Street, Friday evening, the 10th, Dr. William McMurtrie in the chair.

The secretary being absent, Mr. Seldner was appointed secretary, *pro tem.*

A communication from the Washington Section was read in reference to conferring with the Chemical Society of London, as to the feasibility of the separate publication of their abstracts after the manner of the *Chemisches Centralblatt*, the preparation of which should be undertaken by both societies conjointly.

The section voted in favor of the project.

A report of the Committee on Patent Legislation recommended continuation of the present committee and its increase from five to ten members, the additional members to be appointed by the chair. Dr. Smith moved acceptance of the report and adoption of its recommendations. The motion was carried.

Papers were read as follows:

"Recent Extension of Our Knowledge Regarding Nitrates as Plant Food," by J. A. Myers.

"Method for the Analysis of Canned Condensed Milk," by Frederick S. Hyde.

"Manufacture of Ether," by Alfred Roos.

"Manufacture of a New Guaiacol Compound," by Ludwig H. Reuter.

"Explosibility of Nitrogen Iodide and Acetylene Copper Compounds and the Use of the Latter for the Manufacture of Alcohol and Ether," by Ludwig H. Reuter.

"Chemistry of the Dynamite Process of Weighting Silk," by Rafael Granja.

"The Chemistry of the Velocitan Process—Quick Tanning," by Rafael Granja.

"Melting-Point as a Cyclic Function," by Thomas Bayley, England. Read by title.

Abstract from minutes of R. Seldner, Secretary *pro. tem.*

DURAND WOODMAN, *Secretary.*

NORTH EASTERN SECTION.

The regular monthly meeting of the North Eastern Section was held February 17th at the Exchange Club, Boston. About fifty members were in attendance. The secretary's report was read and approved. A letter was read from the secretary of the Washington Section asking for action on a resolution adopted by that section. In accordance with this request the question was placed before the section and it was unanimously voted to recommend to the council to provide for a conference with the Chemical Society of London as to the feasibility of the separate publication of their abstracts after the manner of the *Chemisches Centralblatt*, the preparation of these abstracts to be undertaken by both societies conjointly.

The president then introduced Mr. Clifford Richardson of the Barber Asphalt Paving Co., who presented an interesting and comprehensive address on asphalt. The speaker described the various sources of asphalt, the peculiar geological formations connected with them, and gave particular attention to the Trinidad asphalt lake, describing experiments made to ascertain its depth, composition, rapidity of inflow, and the like. The chemical composition of the bitumen was also considered in some detail. A lengthy discussion followed the paper, and a vote of thanks was extended to the speaker.

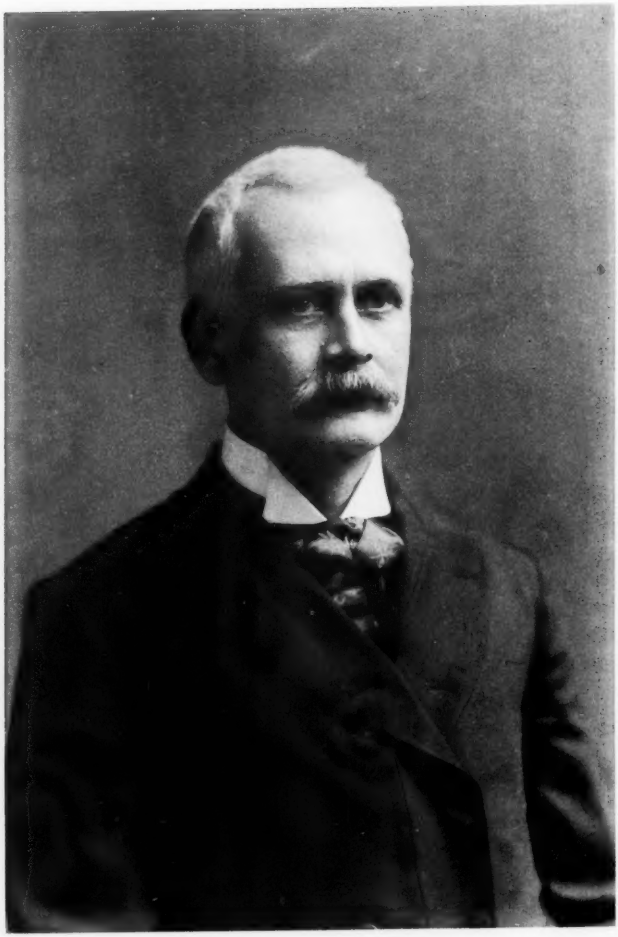
Professor H. P. Talbot then presented a criticism of Carnot's "Traite d'Analyse," a new work on analytical chemistry, to consist, when complete, of three volumes of a thousand pages each.

Professor L. P. Kinnicutt called the attention of the members to a new form of compound blowpipe of neat design. He also described the form of apparatus devised by Dr. G. W. Fitz, of Harvard College, to be used for the determination of carbon dioxide in the air. The simplicity of the apparatus and of its manipulation makes it available for the use of inexperienced persons. According to the work of some of Professor Kinnicutt's students, the accuracy of the results obtained with it leave little to be desired.

Mr. A. D. Little exhibited two samples of artificial silk, one made from nitrocellulose and the other from ordinary glue treated with formaldehyde. The processes of manufacture were also described. Mr. Little also presented some samples of photographic dyeing of cotton cloth. The cloth was sensitized with a bichromate solution, was exposed in the usual way beneath a negative, and the prints were developed by the use of various organic dyes.

After the adjournment of the meeting an informal lunch was served.

W. R. WHITNEY, *Secretary.*



Very truly yours
Charles E. Munroe

Issued with April Number, 1899.

Proceedings.

BOARD OF DIRECTORS.

MINUTES OF THE MEETING OF THE BOARD OF DIRECTORS OF THE AMERICAN CHEMICAL SOCIETY.

The meeting was held in the Chemists' Club, 108 W. 55th St., New York City, Friday evening, March 10, 1899. The meeting was called to order at 7.40 P. M., by President Morley. The directors present were Messrs. Morley, Chandler, Hale, McMurtrie, and Doremus. The secretary read a telegram from Dr. Charles B. Dudley, director, regretting his inability to be present, on account of the illness of two of his assistants.

Minutes of previous meetings were approved as recorded. The following resolutions were adopted :

1. *Resolved*, That Albert C. Hale, secretary, and Charles F. McKenna, treasurer, and their successors in office, shall have the right of access to the safe (No. 13,580) in the vaults of the Mercantile Safe Deposit Company, standing in the name of this society.

2. *Resolved*, That the secretary of the society be directed to move that the motion of Dr. Hillebrand with reference to the question of appointing a committee to communicate with the Chemical Society of London in regard to the matter of publishing abstracts, be referred to the Committee on Abstracts and Reviews which was appointed by the directors at their meeting held October 7, 1897 ; that this Committee be increased to five members by appointment by the president of the society ; and that said Committee be instructed to investigate the matter mentioned in Dr. Hillebrand's motion, and to report to the council as promptly as possible.

3. *Resolved*, That bids for printing and binding 3,000 copies of the index of the first twenty volumes of the Journal, prepared by Mr. M. D. Sohon, be obtained by the secretary of the society, and that he be authorized to let the work to the lowest bidder who will give sufficient assurance that it will be done satisfactorily, in uniform style with the printing and binding of the Journal.

Resolved, further, that a copy of the index be furnished to

each member of the society, if desired, for fifty cents ($0.50), and that the price of the index to non-members be fixed at seventy-five cents ($0.75) per copy.

4. *Resolved*, That the sum of two hundred dollars ($200) be, and the same is hereby appropriated and payable to the treasurer of the society for the expenses of his office during the year 1899.

5. *Resolved*, That the investment of the sum of one thousand, one hundred and sixteen dollars and ninety-eight cents ($1,116.98) in purchasing a $1,000 New York City 3½ per cent. gold bond, at 110½ and accrued interest, for the benefit of the Life Membership Fund, as made by the treasurer after consultation with the Finance Committee and those of the directors who were accessible, be and the same is hereby authorized and approved by the board of directors.

6. *Resolved*, That in accordance with the request of the treasurer, Charles F. McKenna, his accounts and his management of the funds of the society during the whole period of his service as treasurer be examined and audited by the Finance Committee of the society.

After a brief statement of the present condition of the treasury by Mr. McKenna, the meeting was adjourned.

ALBERT C. HALE, *Secretary.*

COUNCIL.

The council has voted that the next meeting be held at Columbus, Ohio, August 21 and 22, 1899, in connection with the session of section C of the American Association for the Advancement of Science.

The following officers have been elected by the council for the term specified :

Albert C. Hale, secretary, for the year 1899.

Edward Hart, editor, for the year 1899.

Charles F. McKenna, treasurer, for the year 1899.

Marston Taylor Bogert, librarian, for the year 1899.

Charles B. Dudley and Charles A. Doremus, directors, for two years beginning January 1, 1899.

Charles A. Doremus, A. A. Breneman, and Peter T. Austen, Committee on Membership, for the year 1899.

A. H. Sabin, A. P. Hallock, and Elwyn Waller, Committee on Finance, for the year 1899.

NAMES PROPOSED FOR MEMBERSHIP.

Bigelow, Henry W., care Pope Mfg. Co., Hartford, Conn.
Cady, Walter B., Agr. Expt. Sta., Columbia, Mo.
Campbell, Archibald, 639 So. 12th St., Ann Arbor, Mich.
Du Vivier, Ernest H., 22 Warren St., N. Y. City.
Divine, Robert E., 75 Niagara St., Buffalo, N. Y.
Fetterman, John C., Western Univ. of Pa., Allegheny, Pa.
Goddard, Henry N., Oshkosh, Wis.
Haywood, W. G., State Chemist's Office, Raleigh, N. C.
Humphrey, Richard L., City Hall, Philadelphia, Pa.
Jones, Frederick W., Barwick Rd., Ware, Herts, England.
Lawson, Thomas W., care Baltimore Copper Sm. & Ref. Co., Keyser Bldg., Baltimore, Md.
Levine, Edmund J., 340 W. 88th St., N. Y. City.
Lihme, C. B., care Ill. Zinc Co., Peru, Ill.
Morton, Cora, Main Ave., Norwood, Hamilton Co., O.
Ritchey, J. C., 506 Washington St., Steubenville, O.
Roberts, W. H., City Hall, Minneapolis, Minn.
Snyder, Oscar, J., Room 23, Y. M. C. A. Bldg., Minneapolis, Minn.
Stevens, Alviso B., 915 Oakland Ave., Ann Arbor, Mich.
Weissmann, 221 Molitor St., Cincinnati, O.
Wetterstroem, Theodore D., Spring Grove Ave. and Copper St., Cincinnati, O.

NAME PROPOSED FOR ASSOCIATE MEMBERSHIP.

Goldstein, Harris, 15 Montgomery St., Manhattan, N. Y. City.

NEW MEMBERS ELECTED MARCH 2, 1899.

Aylsworth, J. W., 165 Cleveland St., Orange, N. J.
Baxter, William T., 47 St. Felix St., Brooklyn, N. Y.
Banghart, Edgar D., Wymore, Nebr.
Bradbury, Robert Hart, Central M. T. School, Philadelphia.
Brewster, Edward E., 316 East C St., Iron Mountain, Mich.
Hamilton, H. C., 637 Baker St., Detroit, Mich.
Hardenburgh, Louis M., Iron Mountain, Mich.
Hazard, F. R., Solvay Process Co., Syracuse, N. Y.
Horton, E. G., Lab. State Board of Health, Columbus, O.
Kendall, Robert Everett, 96 Warren St., Glens Falls, N. Y.
Koch, Charles F., 2334 Ashland Ave., Cincinnati, O.
Lamar, William Robinson, 55 W. 127th St., N. Y. City.
Lamborn, Leebert L., care Curtis Davis & Co., 136 State St., Boston, Mass.
Lee, Waldemar, 2802 W. Lehigh Ave., Philadelphia, Pa.
Linton, J. H., 3012 Wabash Ave., Chicago, Ill.
McCay, Leroy Wiley, Princeton, N. J.

Neiman, Howard S., 8 E. 97th St., N. Y. City.
Porter, Arthur F., 143 Lexington Ave., N. Y. City.
Rippetoe, J. J., Vallejo, Cal.
Rogers, Allen, Univ. of Maine, Orono, Me.
Schober, W. B., Lehigh Univ., South Bethlehem, Pa.
Spieler, Augustus J., Syracuse, N. Y.
Street, John Phillips, New Brunswick, N. J.
Wiener, William, 62½ Nelson Place, Newark, N. J.
Wilkens, H. A. J., care N. J. Zinc Co., 52 Wall St., N. Y. City.
Witherspoon, Thomas A., 27 Iowa Circle, Washington, D. C.

ASSOCIATES ELECTED MARCH 2, 1899.

Cayvan, Llewellyn L., 660 Sixth Street, South Boston, Mass.
Driehaus, Irwin W., Madisonville, O.
Fetsch, William, 2530 W. 6th St., Cincinnati, O.
Hildreth, Edward T., 87 University Road, Brookline, Mass.
Ripley, Philip F., Andover, Mass.
Russell, George F., care Russell Paper Co., Lawrence, Mass.
Young, Charlotte S., Mt. Hope Road, Price Hill, Cincinnati, Ohio.

CHANGES OF ADDRESS.

Austen, Peter T., 52 Beaver St., N. Y. City.
Axtell, Frank C., Box 116, Short Hills, N. J.
Aylsworth, J. W., 223 Midland Ave., East Orange, N. J.
Culmann, Julius, Barrett House, Engle St., Englewood, N. J.
De Benneville, James S., University Club, 1510 Walnut St., Philadelphia, Pa.
Lustig, A. L., Care Lexington Print Works, Canton, Mass.
Mallory, J. Halsey, Care Georgia Cotton Oil Co., 409 Fitten Bldg., Atlanta, Georgia.
Miller, P. Schuyler, Mt. Prospect Lab., Flatbush Ave., Brooklyn, N. Y.
Wilder, S. W., Jr., 13 Pearl St., Boston, Mass.

MEETINGS OF THE SECTIONS.

WASHINGTON SECTION.

The regular meeting of the Washington Section was held on February 9, 1899.

The first paper of the evening was read by Mr. F. D. Simons, and was entitled, "The Detection of Caramel Coloring-matter in Spirits and Vinegar," by C. A. Crampton and F. D. Simons.

"The paper states that the two principal tests given in the books for the detection of caramel coloring-matter are, first, the

reduction of Fehling's solution, and second, the precipitation of the caramel by means of paraldehyde. Neither of these tests has given satisfactory results in the hands of the authors.

"It was found that fuller's earth had a selective affinity for caramel coloring-matter in spirits, while the natural color derived from wood was but slightly affected. The test is made by beating up twenty-five grams of the earth with fifty cc. of the sample to be tested, allowing it to stand thirty minutes at room temperature, and filtering. The color before and after treatment is observed by Lovibond's tintometer or other good form of colorimeter, and the amount of color removed ascertained in this way.

"The test was applied to all the samples of spirits available in the Laboratory of Internal Revenue, positive results being obtained in all cases. A series of forty samples known to be naturally colored, gave an average of 14.6 per cent. of color removed, while eighteen samples of the spirits known to be colored with caramel averaged 44.7 per cent. of color removed. The test was also applied to a few samples of vinegar with good results."

The second paper of the evening was read by Dr. David T. Day, and was entitled "Characteristics of Iridosmium in the United States."

"A demand has lately arisen for this material as a source of osmium, with which it is proposed to impregnate the filaments of incandescent lights with most beneficial results, as to the amount of light supplied by a given current and the increased life of the lamp. The problem of supplying a large amount of osmiridium is a most fascinating one and has led to much study in the localities of the West where platinum metals have been found. The results show that platinum is much more generally distributed through the western placer mines than was supposed and that there are many localities containing so-called crude platinum, in which osmiridium is found. A sample sent from the Oregon beach contained as high as ninety-nine per cent. of osmiridium. The Hay Fork District, in Trinity County, California, Junction City, and more especially the whole Pacific Coast beach is a most interesting field of search, because the platinum is mixed with much osmiridium. It can be said in general that nearly all the crude platinum sand contains osmiridium in greater or less quantity, according to the analyses of a great number of samples made by Dr. Waldron Shapleigh for the Welsbach Light Company. An interesting exception is the Granite Creek district in British Columbia. A curious form of osmiridium was noted at the Chapman Mine, near Junction City, California, where nuggets one-half inch in diameter, when

treated with warm dilute aqua regia, yield platinum in solution, and flakes of osmiridium. The separation of the platinum from osmiridium is readily accomplished by means of aqua regia and the separation of osmic acid from the residue is quite simple by the ordinary process of passing chlorine over the osmiridium mixed with salt. The purification of the osmic acid is now effected by redistillation, but it is probable that these methods will be much improved in the next few months. It is probable that 2,000 ounces of the material will be obtained during 1899."

The last paper of the evening was read by Dr. Day, and was entitled "Uses of Fuller's Earth as a Filtering Medium."

"In 1892 an effort was made by the Owl Cigar Manufacturing Company, at Quincy, Florida, to manufacture brick from a peculiar cream-colored clay found on their property. Instead of baking hard, it exfoliated in a peculiar manner and caused some comment from an Alsatian cigar-maker in the employ of the company, who noticed this clay and called attention to its close resemblance to German fuller's earth. This led to an inquiry as to its value as fuller's earth, at a time when the lubricating oil companies were looking for domestic fuller's earth, to replace animal charcoal as a means of lightening the color of lubricating oils by filtration. The earth proved very suitable and its use extended in this direction as well as to some extent to the bleaching of vegetable oils. But for the latter purpose the imported fuller's earth is still approved. The number of samples of clays which have been called fuller's earth and sent to the consumers for examination since that date, is almost beyond belief. It has been shown that fuller's earth is quite widely scattered in the northwestern counties of Florida and the adjacent counties of Georgia.

"In the latter region the fact that it grades into chalcedony makes it more probable that the fuller's earth is a chemical precipitate and this is further indicated by the replacement of calcium carbonate by the silica in many shells found associated with the fuller's earth.

"The Florida and English fuller's earths differ greatly in appearance and to some extent in chemical composition. English fuller's earth has found its analogue in the material discovered at Fairburn, near Rapid City, South Dakota, and Valentine, Nebraska. It is altogether probable that further developments will make the material from these places an important article for use in bleaching cottonseed oil. There is an interesting difference in the method of testing the Florida fuller's earth as compared with the English. It is the constant practice of the lubricating oil companies to simply fill large slightly conical cylinders with the fuller's earth, ground to about forty mesh,

through which the oil is filtered at about a temperature equal to that of boiling water. At first the filtrate is perfectly colorless and, strange to say, lighter in specific gravity and more fluid than the unfiltered oil, a fact which will probably be made use of in chemical separations of the future. I am now using this in investigating oils. Fuller's earth is used for bleaching refined golden cottonseed oil to a light straw color. When the resultant oil is to be used for white products, such as lard substitutes, the fuller's earth is ground to a fine powder and stirred into the oil slightly above the temperature of boiling water. After a thorough mixing by agitation for a few moments the bleached oil is simply filtered through bag presses. Perhaps the most interesting feature of this use of fuller's earth is the very slight difference in the two varieties of fuller's earth in regard to their bleaching capacity, which leads to their acceptance or rejection. Little regard is paid to chemical analysis, but the tests made by filtration on a small scale are most severe."

WILLIAM H. KRUG, *Secretary.*

CINCINNATI SECTION.

The sixty-sixth regular meeting of the section was held on Wednesday, February 15th, in the Chemical Lecture Room of Hanna Hall, University Buildings, with twenty-one members present, and President Simonson in the chair.

Prof. T. H. Norton gave some additional information regarding the occurrence of the diamond in Wisconsin, in continuation of his paper read at the December meeting on this subject. Dr. William Groff then made a brief but interesting report on some curious phenomena observable at some of the Egyptian pyramids, notably the will-o'-the-wisp, a phenomenon that has given rise to much superstitious interpretation by the inhabitants of that region. The possible origin of this phenomenon was the subject of some discussion. Prof. George Jackson then read a short paper on the discovery of radium, a new element, and on the occurrence of hydrogen in the atmosphere as a regular constituent. Prof. John Uri Lloyd finally gave some interesting notes on the early history of salicylic acid in the United States. In this connection he called attention to a peculiar reaction which takes place between salicylic acid and borax, resulting, under certain conditions, in the formation of an exceedingly bitter compound. This reaction was observed by Prof. Lloyd and others many years ago, and was studied in detail by E. Jahns in 1878.[1]

S. WALDBOTT, *Secretary.*

[1] *Arch. d. Pharm.*, **212**, 212.

NEW YORK SECTION.

The regular monthly meeting of the New York Section of the American Chemical Society was held on Friday evening, the 10th inst., at the Chemists' Club, 108 West Fifty-fifth street, Dr. Wm. McMurtrie presiding and eighty-five members present. Dr. Doremus made a special announcement of the annual exhibition of the New York Academy of Sciences, and urged any members having new and interesting material to contribute the same to the exhibits.

The following papers were then read :

(1) "Preparation of Graphitoidal Silicium," by Frederick S. Hyde.

(2) "The Conservation of Energy in the Human Body," by W. O. Atwater.

(3) "Paraffin as an Adulterant of Oleomargarine," by Joseph F. Geisler.

(4) "Manufacture of Pure Phenyldimethylpyrazolonsulphonic Acid," by L. H. Reuter.

(5) "Manufacture of β-Naphthalenesulphonic Acid and Benzoylsulphonic Acid for the Manufacture of Ether," by L. H. Reuter.

(6) "On the Determination of Sulphur in Sulphites," by A. Bourgougnon.

While the first paper was before the meeting, the president of the society, Prof. E. W. Morley, of Cleveland, arrived, and was invited to take the chair. He made a few remarks on the interest taken in the section by its members, as evidenced not only by the full attendance and interesting list of papers to be read at this meeting, but by the uniformly high character and abundance of material announced for each and every meeting.

Prof. Atwater stated that the large calorimeter chamber in which a man can live for a week or more at a time, has been so perfected that an analysis of pure alcohol by combustion can be made in it to within one-tenth per cent. of the theoretical composition. The results on the calorific value of foods as consumed in the human body, agree very closely with the results calculated from experiments with the bomb calorimeter. The chief difficulties at present are in regard to certain constants, as for instance the value of the calorie, the latent heat of evaporation of water at

different temperatures, etc. The calculation of the observations from a week's run of the calorimeter chamber is itself an arduous and exacting piece of work. Thus far the law of the conservation of energy in the human body is fully demonstrated, within a very small error, which it is hoped to eliminate entirely.

J. F. Geisler exhibited a sample of paraffin extracted from adulterated butter, which contained about forty-five grains of the wax per ounce.

Butter samples had been purchased in New York and vicinity containing from 5 to 11.75 per cent. paraffin.

DURAND WOODMAN, *Secretary.*

NORTH CAROLINA SECTION—ANNUAL MEETING, FEB. 11, 1899.

The fourth annual meeting was held in the office of the state chemist in Raleigh, beginning at 11.30 o'clock, A.M. Thirteen members were present. Reports were read from the Committee on Membership, and from the delegates to the first and second conventions of the National Pure Food and Drug Congress.

A communication was read from the general secretary informing the section that its request as to headquarters and territory were approved by the society. The section decided to approve the recommendation of the Washington Section requesting publishers to make announcements of new books on library cards of standard size. The section decided to join with the Washington Section in recommending to the society the publication of abstracts jointly with the Chemical Society of London. The secretary was authorized and instructed to have printed the announcement of the section for 1899.

The following officers were elected for the ensuing year:

President: Dr. Charles Baskerville, University of N. C., Chapel Hill.

Vice-President: Prof. Charles E. Brewer, Wake Forest College, Wake Forest.

Secretary and Treasurer: Mr. Charles B. Williams, Assistant State Chemist, Raleigh.

Member of Council for 1900: Prof. W. A. Withers, A. and M. College, Raleigh.

The following papers were read:

1. President's Address: "The Nature of Valence," by Dr. F. P. Venable.

2. "An Observation on Free and Albuminoid Ammonia in Drinking Water," by Prof. A. W. Blair.

3. "On the Occurrence of Chromium and Titanium in Peats from the Dismal Swamp," by Dr. Charles Baskerville.

4. "Iron and Aluminium Phosphates in Commercial Fertilizers," by Mr. Charles B. Williams.

5. "The Action of Sodium Malonic Methyl Ester on Dichloroxalic Methyl Ester," by Dr. Thomas Clarke.

6. "Food Adulteration in North Carolina," by Prof. W. A. Withers.

7. "Some Organic Salts of Zirconium," by Dr. F. P. Venable.

8. "A New Burette Holder," by Dr. J. M. Pickel.

9. "The Condensation of Chloral with Ortho-, Para-, and Metanitraniline," by Dr. Charles Baskerville.

10. "A Preliminary Report on Secondary Heptylamine," by Dr. Thomas Clarke.

11. "A Case of Spontaneous Combustion," by Dr. Charles Baskerville.

W. A. WITHERS, *Secretary.*

RHODE ISLAND SECTION.

The regular monthly meeting of the Rhode Island Section of the American Chemical Society was held at the Hope Club, Providence, January 26, 1899, at eight o'clock, with Mr. Edward D. Pearce as presiding officer.

After dinner, Mr. Walter M. Saunders presented the paper of the meeting on "Alloys." His remarks were supplemented by lantern-slides, showing phenomena connected with the dissolving of one metal in another, and the subsequent crystallizing when cooled.

Attention was called to the fact that varying proportions of common salt and water change materially the solidifying-point of the mixture. On a chart it was shown that the freezing-point of the mixture is lowered until a so-called eutectic alloy is obtained, when the point again is higher, according to the proportions. From analogy the same is observed in certain mixtures of metals.

The regular monthly meeting of the Rhode Island Section of the American Chemical Society was held at the Hope Club, Providence, February 23, 1899, at eight o'clock, with Mr. Edward D. Pearce as presiding officer.

After dinner, the members and guests went to the Chemical Laboratory of Brown University. Dr. E. A. Fourneaux presented the paper of the evening on "The Process of Mercerizing."

When cotton cloth or yarn is immersed in a strong solution of caustic soda for a few seconds, washed and stretched, the condition of the fiber is greatly changed in appearance and in its conduct towards dye-stuffs. Dr. Fourneaux was able to show by experiments, performed before his audience, how samples of the same kind of cloth dyed with a common material but treated differently in mercerizing, may vary in finish and shade. If the cloth is printed with substances which protect the fibers in the process of mercerizing and then dyed, a figure may appear on the surface, caused by the difference in shade between the parts mercerized and dyed, and the parts unmercerized and dyed.

WALTER E. SMITH, *Secretary.*

CORRESPONDENCE.

To the Editor of the Journal:

MY DEAR PROFESSOR HART: In connection with the minutes of the meeting of the Board of Directors enclosed herewith, I would like to call the attention of the members of the society especially to the investment which has just been made for a permanent "Life Membership Fund," and also to the fact that this has been promptly followed by the payment of a life membership fee of $100, just received from Professor Charles E. Munroe. Doubtless there are others who will be glad to avail themselves of the opportunity of becoming life members or life associates, when they know that the policy of the society is now definitely fixed to maintain a permanent fund, separately invested, covering all life membership fees which the society has ever received, or which shall hereafter be paid; and that this fund will be administered in accordance with the following provisions of the Constitution:

"Article I, Section 6. Any member or associate, not in arrears, paying at any one time the sum of one hundred dollars

into the treasury of the society, as commutation for dues, shall become a life member or life associate, shall be exempt from the further payment of annual dues, and shall receive all the regular publications of the society."

"Article X, Section 2. All funds received for life membership shall be invested as soon as possible and shall constitute a trust fund to be known as the 'Life Membership Fund,' which shall be held in perpetuity to guarantee the future interests of such life members. The interest of such fund not required for the above-named purposes shall be set aside as a 'Research Fund,' from which appropriations may be made annually by the council, but only for the purposes of chemical research."

Yours very truly,

ALBERT C. HALE,

Secretary of the American Chemical Society.

Issued with May Number, 1899.

Proceedings.

COUNCIL.

The Council has authorized the establishment of a section to be known as the Philadelphia Section, with headquarters in Philadelphia, Pa., and with a territory with a radius of sixty miles from the Philadelphia City Hall where this does not conflict with the territory of any existing section.

NAMES PROPOSED FOR MEMBERSHIP.

Austin, Ned M., Leechburg, Pa.
Bancroft, Wilder D., 7 East Ave., Ithaca, N. Y.
Brown, Herman E., Coldwater, Mich.
Carel, Herbert C., Dept. of Med., Univ. of Minn., Minneapolis, Minn.
Chace, Edward M., Berwyn, Md.
Clements, Frank O., Westerville, Ohio.
Cook, Charles G., Boys' High School, Brooklyn, N. Y.
Faust, John K., Carpenter Steel Co., Reading, Pa.
Folsom, Herbert A., Atlantic Mills, Olneyville, R. I.
Foster, John, Woodward, Ala.
Hinckley, J. Fred., care B. T. Babbitt & Co., N. Y. City.
Lloyd, George, 52 Dearborn St., Chicago, Ill.
Longstaff, J. P., Chem. Lab., Univ. of Edinburgh, Scotland.
Loos, Edward A., 933 N. Front St., Philadelphia.
McDowell, Alexander H., 457 W. 21st St., N. Y. City.
Motion, John, care John Ellis & Co., Edgewater, N. J.
Nelson, N., Ill. Steel Co., South Chicago, Ill.
Nichols, Herbert T., Springs Junction, Arizona.
Primrose, H. W., Exp. Station, Raleigh, N. C.
Pullman, F. Cooper, Carpenter Steel Co., Reading, Pa.
Van Brunt, Charles G., Augustine, Kas.
Ware, Ezra J., 221 Baldwin Ave., Detroit, Mich.
Worden, Edward C., 103 W. 42nd St., N. Y. City.

NAMES PROPOSED FOR ASSOCIATE MEMBERSHIP.

Ashley, Harrison E., 6 Rutland Square, Boston, Mass.
Darke, Jesse M., Gen. Elec. Steel Foundry Co., West Lynn, Mass.

Knight, Geo. W., 38 Rosseter St., Boston, Mass.
Powell, Thomas H., 53 S. Main St., South Norwalk, Conn.
Skinner, Hervey J., 15 Chestnut St., Wakefield, Mass.
Summey, Albert E., 46 Main St., Bradford, Pa.
Teasdale, Wm. S., The Teasdale Dye House, Race St., Cincinnati, Ohio.

CHANGES OF ADDRESS.

Arnold, Fred. N., Jr., 117 Huffman Ave., Dayton, Ohio.
Austen, Peter T., 218 St. Johns Place, Brooklyn, N. Y.
Best, Otto, Daggett, Cal.
Briggs, T. Lynton, Box 533, Ridgewood, N. J.
Cottle, George T., 39 Curtis Ave., Wallingford, Conn.
Gies, William J., 437 W. 59th St., New York City.
Hall, Arthur W., care Ziegler Electric Co., 141 Franklin St., Boston, Mass.
Hanna, Prof. Geo. B., Box 26, Charlotte, N. C.
Hicks, Edwin F., 203 W. 81st St., New York City.
Jones, Clemens C., 908 W. Franklin St., Richmond, Va.
Kelley, J. H., 321 N. Vine St., Nashville, Tenn.
LaBach, J. O., Pleasant Ridge, Hamilton Co., Ohio.
Lerch, Fred., Hibbing, Minn.
Ludlow, Gabriel, The Commercial Guano Co., Savannah, Ga.
Maury, G. P., Mount Iron, St. Louis Co., Minn.
Nelson, E. K., 159 E. 47th St., Chicago, Ill.
Poole, Herman, 357 Canal St., N. Y. City.
Quinan, W. R., Wellington, South Africa.
Roller, H. C., Roselle, N. J.
Saltar, J. C., Pemberton, N. J.
Schweitzer, Hugo, 427 W. 117th St., N. Y. City.
Seamon, W. H., Box 97, El Paso, Texas.
Smith, Horace T., 137 E. Main St., Bridgeport, Conn.
Takamine, Jokichi, 475 Central Park, West, New York City.
Thatcher, Charles, 132 Columbia Heights, Brooklyn, N.Y.
Van Ingen, Dudley A., care N. J. Zinc Co., Newark, N. J.
Wakeman, Alfred J., Greenwich, Conn.
Wigfall, E. Newton, Box 257, Somerville, N. J.
Wolcott, James T., 255 Ellicott St., Buffalo, N. Y.

MEETINGS OF THE SECTIONS.

CHICAGO SECTION.

The February meeting of the Chicago Section was held at the Technical Club on Thursday, the 28th. The program consisted of a paper by Wm. Hoskins "On the Chlorination of Gold

Ores." This was followed by a general discussion of the subject.

At the 27th regular meeting of the Chicago Section held at the Technical Club, March 29th, Mr. Clement W. Andrews, Librarian of the John Crerar Library, gave a paper on "Some Proposed Recent and Proposed Scientific Bibliographical Work." Prof. W. D. Bancroft, of Cornell University, then gave an informal talk on the relation between physical chemistry and technical chemistry.

F. B. DAINS, *Secretary.*

COLUMBUS SECTION.

Since the last report, the following papers have been read and discussed before the Columbus Section.

1. "The Summer Meeting of the American Association for the Advancement of Science," by Prof. H. A. Weber.

2. "Technical Analysis" by Prof. N. W. Lord.

The speaker discussed "Short Methods" in chemical analysis and called attention to the danger of devoting too much time to teaching them at the expense of the training of students in chemical science, thus giving a sort of "cook-book" knowledge of chemical processes; the student is thus left poorly prepared to meet the demand for wide-awake chemists ready for whatever may come to them in the rapidly increasing range of analytical necessities.

3. "Essential Oils" by Prof. G. B. Kauffman.

The subject was considered under two heads:

a. Natural oils—their source, preparation, and properties.

b. Artificial oils—their preparation, properties, and relation to the corresponding natural oils. In some cases, as oil of wintergreen, the two are identical, while in others they simply possess similar properties.

Attention was called to the frequent use of the artificial for the natural products and of the difficulty which the physician and pharmacist experience in distinguishing between the two. Even in the case of oil of wintergreen, there is still a demand for the natural product.

4. "Drug-Using and Drug-Proving," by Prof. C. A. Dye.

The speaker discussed the distinction usually made between empirical and rational therapeutics, and gave a general outline of the methods employed for scientific drug-proving, including the experiments on the lower forms of life, and the application of the knowledge thus obtained to the treatment of diseases.

5. "The Winter Meeting of the American Chemical Society," by Prof. W. A. Henderson.

The following officers have been elected for the ensuing year:

President—H. A. Weber.

Secretary—William McPherson.

Treasurer—O. R. Flynn.

Executive Committee—H. A. Weber, Wm. McPherson, and O. R. Flynn.

Member of Council—N. W. Lord.

Committee on Membership—Geo. B. Kauffman, A. M. Bleile, and N. W. Lord.

The section has accepted an invitation from the Cincinnati Section for a joint meeting to be held on the evening of April 15th.

The following are the abstracts of the papers presented at the regular monthly meeting held April 5, 1899.

Mr. Foulk gave a short account of his experience with the solubility of platinum in fused sodium carbonate. When an iron ore is fused and subsequently titrated with bichromate after reduction with stannous chloride, the complication introduced by the presence of small amounts of platinum is very troublesome and may lead to a serious error in the result.

A direct experiment showed that in one hour 14.3 milligrams of platinum were dissolved from forty-four cm. surface exposed.

Mr. Foulk referred to the absence of any reference in the text-books to this solubility of platinum and gave the few statements in the periodical literature which he had been able to find. Under the ordinary conditions of a fusion, from one-half to one milligram of platinum was dissolved from the crucible. This agreed with the experiments of Dr. Koenick and Mahon which were referred to.

Mr. Peppel read a short paper giving the results of some experiments on the stability of sodium thiosulphate solutions. The conflicting statements of the text-books and of the periodical literature were first referred to and then the results of a series of laboratory experiments were given.

Various methods were used in preparing the thiosulphate but in only one case—when the recrystallized salt had been washed in ether and alcohol—was a product obtained, the calculated weight of which could be used in preparing standard solutions. By using ordinary care in making up the solutions, Mr. Peppel found them to remain constant for four months which was the time the experiments had been going in. No extra precautions

were taken in keeping the thiosulphate. Solutions were contained in clear glass bottles and in no way protected from the light.

Mr. Vinson discussed the "Mechanical Separation of Butter-fat from Milk." The Alpha separator which was used in his experiments was explained by means of charts. The milk separated from the butter-fat by this machine showed the presence of 0.01 per cent. butter-fat according to the Babcock tester. Careful analyses made by the Adams method, using sufficient paper to absorb fifteen grams of the milk, gave 0.11 per cent. butter-fat. The separators used in the University Dairy School recover ninety-eight per cent. of the butter-fat. Some observations were also given on the melting-point of butter-fat from pasteurized milk, which subject the author will carefully investigate.

WILLIAM MCPHERSON, *Secretary.*

CINCINNATI SECTION.

The sixty-seventh regular meeting of the section took place on Wednesday, March 15th, in the Chemical Lecture Room of Hanna Hall, University Buildings, and was the occasion of a joint meeting with the Cincinnati Academy of Pharmacy. Twenty-three members were in attendance, President Simonson in the chair.

A resolution adopted by the Washington Section having been received and communicated at the previons meeting, with reference to the feasibility of suggesting to the London Chemical Society, through appropriate channels, the separate publication of their "Abstracts" under the auspices of the London and the American Chemical Societies, conjointly, was unanimously endorsed at this meeting.

Prof. John Uri Lloyd read a paper, entitled "An Investigation into 'Husa,' an Asserted Plant Preparation to Cure the Opium Habit."

Prof. Lloyd was able to secure authentic specimens of the preparation consisting of ten numbered bottles, each containing about ninety cc. of a uniformly brown liquid. According to a printed label they bear, the collection represents the amount to be used in the first month's treatment. The cost of this supply is ten dollars. A preliminary analysis of the contents of one of the bottles brought to light the following ingredients: Morphine 1.3 per cent. (approximately), present as sulphate; salicylic acid, 0.16 per cent.; alcohol, 12 per cent.; glycerol 10 per cent., and coloring-matter, probably burnt sugar.

A subsequent assay of each of the ten specimens for morphine showed that the quantity of morphine present gradually de-

creased from 2.19 per cent. to 1.33 per cent. The morphine obtained conformed to all the tests of the U. S. Pharmacopœia, and in addition, to Mayer's alkaloidal test as well as to the iodic acid test.

A prolonged discussion followed the reading of the paper.

Upon motion, the meeting adjourned.

S. WALDBOTT, *Secretary.*

NEW YORK SECTION.

The regular monthly meeting of the New York Section of the American Chemical Society was held at the Chemists' Club, 108 West Fifty-fifth Street, on Friday evening, April 7th, Dr. Wm. McMurtrie presiding, and about sixty-five members present.

The following papers were read: "The Toxic Action of Sodium Fluoride," by H. B. Baldwin. "The Chemistry of the By-products of Coke Ovens," by J. D. Pennock. "Notes on the Chemistry of the Carbides," by J. A. Matthews. "The Distribution of Alkali in Montana," by F. W. Traphagen and W. M. Cobleigh; read by Mr. Cobleigh.

DURAND WOODMAN, *Secretary.*

CORRESPONDENCE.

UNITED STATES COMMISSION TO THE PARIS EXPOSITION OF 1900.

CHICAGO OFFICES, April 4, 1899.

GENTLEMEN:

For the benefit of the trade which you represent will you please state that all who desire to exhibit in the Paris Exposition of 1900 are requested to immediately notify this office, if they have not already done so, in order that they may be considered in the allotment of space which will soon be made. While there are many applications on file in every line of industry, it is desirable that the American Sections be not only representative of this country but also represent the largest possible number of producers. Both our commercial interests and national pride demand that our works be entered in this most important International Exposition. It is estimated that fully 60,000,000 people from every part of the globe will attend, and it will be an opportunity to greatly increase our foreign trade and to demonstrate that the United States is supreme in tne arts of peace.*** Respectfully,

JOHN H. MCGIBBONS,
Director of Exploitation.

Approved, FERDINAND W. PECK,
Commissioner-General.

Issued with June Number, 1899.

Proceedings.

COUNCIL.

The resignation of Charles F. McKenna was accepted by the Council, April 28, 1899, the Council adopting the following resolutions:

"*Resolved*, That the Council of the American Chemical Society, in accepting the resignation of Dr. Charles F. McKenna, Treasurer, takes such action with very deep regret, and only upon the urgent representation by Dr. McKenna that the demands of his private business prevent any consideration of his continuing to perform the duties of said office.

"*Resolved*, Further, that the Council, in behalf of the Society, herewith expresses to Dr. McKenna its high appreciation of his long-continued, faithful, and laborious services as Treasurer, and its sincere thanks for the efficient administration of the duties of his office. It is a matter of special gratification to the officers and members that the financial affairs of the Society are to-day in better condition than ever before, and the Council takes pleasure in recording that this result is very largely due to the wise, conservative business management of the retiring Treasurer."

At the same time Albert P. Hallock was elected Treasurer of the Society.

On May 9, the Council adopted the following resolutions:

(1) *Resolved*, That the resignation of Mr. Marston Taylor Bogert as Librarian of the American Chemical Society be accepted, and that the thanks of the Society be hereby tendered to Mr. Bogert, through the Council, for his efficient services in that office.

(2) *Resolved*, That Professor A. A. Breneman be, and is hereby, authorized and employed to serve as Acting Librarian of the American Chemical Society until a permanent librarian shall be elected.

The Librarian has been authorized to have an edition of 300 copies of the Journal for January, 1899, printed by the Chemical Publishing Company at $1.05 per page, according to the bid submitted by said Company.

NAMES PROPOSED FOR MEMBERSHIP.

Eckfeldt, Jacob B., U. S. Mint, Phila., Pa.
Ellery, James B., 12 Ellsworth Ave., Cambridge, Mass.
Gifford, Wm. E., 69 6th St., Long Island City, N. Y.
Goldman, A., 45 Cedar St., N. Y. City.
Griffith, Mary Dechert, 3914 Walnut St., Phila., Pa.
Heidenhain, Heinrich, care Price Baking Powder Co., Michigan St. and Dearborn Ave., Chicago, Ill.
Hough, George J., 2235 Sheridan Pl., Evanston, Ill.
Lengfeld, Felix, Chicago Univ., Chicago, Ill.
McClement, W. T., Armour Inst. of Tech., Chicago, Ill.
Meyer, Frederick L., 2028 Park Ave., Phila., Pa.
Miller, Armand R., 812 Euclid Ave., Kansas City, Mo.
Moore, Russel W., Appraisers' Stores, Washington & Christopher Sts., N. Y. City.
Newman, Jacob W., Empire Hotel, N. Y. City.
Perkins, Albert S., Dorchester High School, Boston, Mass.
Phinney, John I., Cambridge Latin School, Cambridge, Mass.
Schlichting, Emil, 61 Hicks St., Brooklyn, N. Y.
Tower, Olin F., Adelbert College, Cleveland, Ohio.
Van Slyke, Lucius L., Expt. Station, Geneva, N. Y.
Williams, Lawrence S., Armour Inst. of Tech., Chicago, Ill.
Woods, R. M., Plano Mfg. Co., West Pullman, Ill.

NAMES PROPOSED FOR ASSOCIATE MEMBERSHIP.

Allen, Lucius E., 213 E. Liberty St., Ann Arbor, Mich.
Semonite, R. G. C., 910 A Greene Ave., Brooklyn, N. Y.

NEW MEMBERS ELECTED APRIL 22, 1899.

Cady, Walter B., Agr. Expt. Station, Columbia, Mo.
Campbell, Archibald, 639 S. 12th St., Ann Arbor, Mich.
Du Vivier, Ernest H., 22 Warren St., New York City.
Fetterman, John C., Western Univ. of Penna., Allegheny, Pa.
Goddard, Henry N., Oshkosh, Wis.
Humphrey, Richard L., City Hall, Philadelphia, Pa.
Jones, Frederick W., Barwick, near Ware, Herts, England.
Lawson, Thomas W., care Baltimore Copper Co., Keyser Bldg., Baltimore.
Levine, Edmund J., 340 W. 88th St., N. Y. City.
Morton, Cora, Main Ave., Norwood, Hamilton Co., O.
Ritchey, J. C., 506 Washington St., Steubenville, O.
Roberts, W. H., City Hall, Minneapolis, Minn.
Stevens, Alviso B., 915 Oakland Ave., Ann Arbor, Mich.
Weissmann, Frederick W., 221 Molitor St., Cincinnati, O.
Wetterstroem, Theodore D., Spring Grove Ave. and Cooper St., Cincinnati, Ohio.

ASSOCIATES ELECTED APRIL 22, 1899.

Bigelow, Henry W., Pope Mfg. Co., Hartford, Conn.
Goldstein, Harris, 15 Montgomery St., New York City.

NEW MEMBERS ELECTED MAY 26, 1899.

Austin, Ned M., Leechburg, Pa.
Bancroft, Wilder D., 7 East Ave., Ithaca, N. Y.
Brown, Herman E., Coldwater, Mich.
Carel, Herbert C., Dept. of Med., Univ. of Minn., Minneapolis, Minn.
Chace, Edward MacKay, Berwyn, Md.
Clements, Frank O., Westerville, O.
Cook, Charles Gilpin, Boys' High School, Brooklyn, N. Y.
Faust, John Kirk, Carpenter Steel Co., Reading, Pa.
Folsom, Herbert A., Atlantic Mills, Olneyville, R. I.
Foster, John, Woodward, Ala.
Hinckley, J. Fred., care B. T. Babbitt & Co., N. Y. City.
Lloyd, George, 52 Dearborn St., Chicago, Ill.
Longstaff, J. P., Chem. Lab., Univ. of Edinburgh, Scotland.
Loos, Edward A., 933 N. Front St., Philadelphia.
McDowell, Alexander H., 457 W. 21st St., N. Y. City.
Motion, John, care John Ellis & Co., Edgewater, N. J.
Nelson, N., Ill. Steel Co., South Chicago, Ill.
Nichols, Herbert T., Hot Springs Junction, Ariz.
Primrose, H. W., Expt. Station, Raleigh, N. C.
Pullman, F. Cooper, Carpenter Steel Co., Reading, Pa.
Van Brunt, Charles, Argentine, Kas.
Ware, Ezra J., 221 Baldwin Ave., Detroit, Mich.
Worden, Edward C., 103 W. 42nd St., N. Y. City.

ASSOCIATES ELECTED MAY 26, 1899.

Ashley, Harrison E., 6 Rutland Sq., Boston, Mass.
Darke, Jesse M., West Lynn, Mass.
Knight, George W., 38 Rosseter St., Boston, Mass.
Powell, Thomas H., 53 S. Main St., South Norwalk, Conn.
Skinner, Hervey J., 15 Chestnut St., Wakefield, Mass.
Summey, Albert E., 46 Main St., Bradford, Pa.
Teasdale, Wm. S., The Teasdale Dye House, Race St., Cincinnati, O.

CHANGES OF ADDRESS.

Andrews, George F., care Cornell and Andrews, Providence, R. I.
Ashby, Geo. J. M., 3716 Wabash Ave., Chicago, Ill.
Bassett, Geo. O., 30 Farnsworth St., So. Boston, Mass.

Böhm, L. K., 320 Broadway, New York City.
Carlsson, Hugo, The Lorain Steel Co., Lorain, Ohio.
Chauvenet, W. M., 620 Chestnut St., St. Louis, Mo.
Clementson, Henry, 445 Greenpoint Ave., Brooklyn, N. Y.
Cobleigh, W. M., care Mont. State College, Bozeman, Mont.
Colby, Albert Ladd, Bethlehem Steel Co., South Bethlehem, Penna.
Corse, W. M., 23 Oakland St., Medford, Mass.
Doan, Miss Martha, Man. Tr. High School, Indianapolis, Ind.
Ellsworth, Wm., 16 Lafayette Ave., Brooklyn, N. Y.
Flynn, O. R., 1620 Neil Ave., Columbus, Ohio.
Fuelling, J. L., P. O. New Durham, N. J.
Gies, Wm. J., 437 W. 59th St., New York City.
Harper, Chas. A., 2139 Gilbert Ave., Cincinnati, Ohio.
Herrick, Rufus F., Box 1768, Boston, Mass.
Hildreth, Edward T., 338 N. Main St., Los Angeles, Cal.
Hopkins, N. Monroe, 1833 Jefferson Place, Washington, D. C.
Howard, Henry, 175 Mountfort St., Brookline, Mass.
Johnson, S. W., Drawer 101, New Haven, Conn.
Krause, A. H., 32 Wellington Ave., Cleveland, Ohio.
Kunze, Wm. F., Hastings, Minn.
Lanning, John G., Horst, Ohio.
Lenher, Victor, Mechanicsburg, Pa.
Linebarger, C. E., 1210 Perry St., Chicago, Ill.
Magruder, E. W., care Standard Oil Co., Whiting, Ind.
Masury, John W., Center Moriches, Long Island, N. Y.
Meader, A. Lloyd, Harris Ave., Norwood, Ohio.
Moran, George A., Box 248, South Framingham, Mass.
Myers, H. Ely, Lincoln Foundry Co., 60th & Butler Sts., Pittsburg, Pa.
Nicholson, Edward E., Univ. of Minn., Minneapolis, Minn.
Parker, Horatio N., 24 Wendell St., Cambridge, Mass.
Pemberton, H., Jr., Longport, Atlantic County, N. J.
Peppel, S. V., Leetonia, Ohio.
Peters, Andrew, Huletts Landing, Washington County, N. J.
Pierson, Willett C., 214 W. 78th St., New York City.
Pugh, A. H., Jr., 1912 Madison Ave., Cincinnati, Ohio.
Schleicher, Francis J., 250 Van Alst Ave., Queenborough, N. Y.
Seidensticker, L. J., Mass. Inst. Tech., Boston, Mass.
Shaw, Wm. T., Great Falls, Mont.
Shorey, Edmund C., Honolulu, H. I.
Smith, Frank M., care American Sm. & Ref. Co., Smelter P. O., Great Falls, Mont.
Steel, Fred. W., care of Cuming Smith & Co., 65 William St., Melbourne, Victoria.
Stocker, John H., 214 Hancock St., Brooklyn, N. Y.

Swett, Charles E., 171 Pleasant St., Providence, R. I.
Taylor, S. F., Box 513, Schoharie, N. Y.
Tutwiler, C. C., 705 United Gas Building, Phila., Pa.
Walker, Percy H., Bowling Green, Caroline Co., Va.
Waterman, C. N., 134 E. 50th St., Chicago, Ill.
Williams, C. B., Box 373, Raleigh, N. C.
Wing, Herbert H., 76 Johnson Park, Buffalo, N. Y.

LEHIGH VALLEY SECTION.

A regular meeting of the Lehigh Valley Section was held in South Bethlehem on Tuesday, May 16, 1899. The Chemical and Metallurgical Sections of the Franklin Institute, had accepted an invitation to participate in this meeting, and arrived from Philadelphia at 2.00 P. M. The party numbered fifty, and occupied a special car. They were met at the station by Dr. Joseph W. Richards, presiding officer of the Lehigh Valley Section, and Mr. C. A. Buck, chief chemist of the Bethlehem Steel Co. Through the courtesy of the officials of the Lehigh Valley Railroad and the Bethlehem Steel Co., the car was transferred to the Valley tracks, and drawn directly to the chemical laboratory of the Steel Works. The party, augmented by the members of the Lehigh Valley Section, were here taken charge of by officials of the company, and conducted on a thorough tour of inspection of the works. The chemical and physical laboratories, the casting house, the blast-furnaces, and the machine shops were all visited and viewed with interest, but the magnificence and grandeur of the large government plant awakened the enthusiasm of the visitors. Big guns and armor plates in all stages of manufacture, from the initial melting of the steel to the final machining of the finished product, were seen. From the steel works the chemists and metallurgists proceeded to the Lehigh University where they were conducted through the grounds and buildings by Dr. Thomas M. Drown and Profs. Chandler, Franklin, Merriman, and Frazier. Luncheon was served in the metallurgical laboratory at 5.30 P. M., and the meeting was called to order in the chemical laboratory at 6.00 P.M. After a short address of welcome by Dr. Richards, presiding officer, the following papers were read and discussed :

" On the Use of Iron in the Purification of Water and Sewage, by Dr. T. M. Drown.

"A New Volumetric Method for Magnesia," by Mr. R. K. Meade.

"The Theodolite Goniometer and Gnomonic Crystal Projection," by Dr. Jos. W. Richards.

"The Manufacture of Graphite in the Electric Furnace," (Exhibition of Specimens), by Dr. Wm. H. Wahl.

"Historical Sketch of the Liquefaction of Gases," by Dr. H. F. Keller.

The papers were all worthy of the eminent scientists presenting them and were listened to with the deepest interest by the eighty members and visitors present. At 7.30 P.M., the meeting was reluctantly compelled to adjourn in order to allow the visitors to catch their train. BERNARD ENRIGHT, *Secretary.*

WASHINGTON SECTION.

The regular meeting of the Washington Section was held on March 9, 1899.

The first paper of the evening was read by Dr. F. K. Cameron and was entitled "Acetone-Chloroform, 2nd paper," by F. K. Cameron and L. J. Briggs.

The second paper was read by Mr. T. H. Means and was entitled "Field Estimation of the Salt Contents of Soil Waters," by T. H. Means and F. K. Cameron.

"This method has been devised for a rapid estimation of the relative proportions of chloride, sulphates, and carbonates in the 'alkali' soils of the western irrigated districts. It is used as a check upon the electrical method for the determination of the soluble salt content of soils, as well as to furnish approximate analyses in the field without waiting for complete analyses to be made in the laboratory. The method determines chlorides, sulphates, and carbonates in terms of the sodium salt. A sample of water is taken, or an extract is made of the soil, and the solution filtered or decanted. The solution need not be clear. An excess of barium nitrate (ten cc.) is added to ten cc. of the salt extract, thus precipitating sulphates and carbonates. The excess of barium nitrate is titrated back with potassium chromate, using silver nitrate on a porcelain plate as an indicator. In the same vessel silver nitrate is added, using potassium chromate on the plate as an indicator, thus precipitating the chloride. A few drops of nitric acid are now added and the liquid heated, driving off the carbon dioxide from the barium carbonate. The excess of nitric acid is neutralized

by powdered magnesium carbonate. Again the solution is titrated with potassium chromate, the quantity required giving the amount of carbonates. This subtracted from the sum of the sulphates and carbonates, as found above, gives the sulphates. This method makes the three titrations in one vessel, the apparatus being of such a simple nature that all can be carried in a camping outfit."

The third paper was read by Mr. J. K. Haywood and was entitled "The Determination of Calcium and Magnesium in Ashes."

"The author has found that in determining calcium and magnesium it is not essential to wash the voluminous precipitate of basic acetate of iron and phosphate of iron, but that results of almost equal accuracy are obtained by making the precipitation in a 500 cc. flask, filling up to the mark, passing through a dry filter and using aliquot portions of the filtrate for analysis.

"The above is substantiated by experimental data."

The last paper was read by Dr. H. C. Bolton and was entitled "The Classification of Chemistry Proposed by the International Committee of the Royal Society, a Critical Analysis," by W. P. Cutter and H. C. Bolton.

"The paper analyzed the proposed scheme of classification of chemical titles drawn up by the Committee on the International Catalogue of the Royal Society. It characterized the system as conglomerate, since numbers, Roman capitals, lower case italic letters and Greek letters are mixed up with alphabetical headings. The system embraces also methods of notation which are very objectionable inasmuch as the symbols are analogous in structure and appearance to chemical formulas, yet they are entirely different. The scheme proposed if intended to facilitate research is pronounced by the authors of the analysis as an almost total failure."

The regular meeting was held on April 13, 1899.

The first paper of the evening was read by Mr. J. K. Haywood and was entitled "Some Boiling-point Curves." The results obtained have led to the following conclusions:

1. All mixtures of the following pairs of liquids boil at temperatures between the boiling-points of the constituents: alcohol-water, alcohol-ether, chloroform-carbon tetrachloride, acetone-water and acetone-ether.

2. A solution containing 17.5 per cent. alcohol in carbon tetrachloride distils without change at 65.5° approximately, under a pressure of 768.5 mm. of mercury.

3. A solution containing 12.5 per cent. methyl alcohol in

chloroform distils without change at 54° approximately, under a pressure of 770.2 mm. of mercury.

4. A solution containing 12–13 per cent. methyl alcohol in acetone distils without change at 55.9° under a pressure of 764.8 mm. of mercury. The boiling-point of this mixture is about 0.8° below that of the constituent which is present in greatest amount.

5. A solution containing 15–20 per cent. of carbon tetrachloride in acetone distils without change at a temperature but 0.05° below that of the pure acetone, and all mixtures containing more than 40 per cent. acetone boil within one degree of the boiling-point of the acetone itself.

6. The close proximity of the boiling-points of the constituents appears to be a favorable condition for the existence of a maximum or minimum point on the boiling-point curve.

7. In general one constituent remaining the same, mixtures with substances of similar chemical constitution, yield similar boiling-point curves.

The second paper was read by Dr. F. K. Cameron and was entitled "Boiling-points of Mixtures."

Dr. H. C. Bolton read an interesting paper on " The Development of Pneumatic Chemistry," which was profusely illustrated with lantern slides.

WILLIAM H. KRUG, *Secretary.*

CINCINNATI SECTION.

The sixty-eighth regular meeting was held on Saturday, April 15, 1899, in the Chemical Lecture Room of Hanna Hall, University Buildings, with sixteen members of the Columbus Section present as invited guests. Of the Cincinnati Section, twenty-seven members were in attendance. The meeting was preceded by an informal dinner at the Grand Hotel. In the afternoon the Columbus guests visited the soap and candle works of the Procter and Gamble Co., Ivorydale, O.

President Simonson called the meeting to order at 8.30 P.M. and invited Dr. H. A. Weber, president of the Columbus Section, to the chair.

Mr. B. M. Pilhashy read a paper on "Recent Discoveries in Fermentation," dwelling on Buchner's researches on fermentation without living cells, and connected subjects. Dr. A. M. Bleile, of the Columbus Section, ably opened the discussion.

A paper "On the Examination of Commercial Flour," contributed to the Cincinnati Section by Prof. Henry Kraemer of

Philadelphia, was then presented, in the absence of the author, by Mr. Arthur O. Jones, and a number of drawings connected with the subject were exhibited.

After extending a vote of thanks to the presiding officer, Dr. Weber, the meeting, upon motion, adjourned.

The sixty-ninth regular meeting was held on Wednesday, May 17, in the Chemical Lecture Room of Hanna Hall, University Buildings, with twenty-seven members present, and President Simonson in the chair.

Prof. Jas. Lewis Howe, of Washington and Lee University, gave a most interesting outline of "Werner's Theory of the Constitution of Inorganic Compounds."

Upon motion, the meeting adjourned.

S. WALDBOTT, *Secretary.*

NEW YORK SECTION.

The regular meeting of the New York Section was held on Friday evening, May 5, 1899, in the Assembly Room of the Chemists' Club, 108 W. 55th St., Dr. Wm. McMurtrie presiding.

Mr. A. H. Allen was the guest of the section and was enthusiastically welcomed, responding with appropriate remarks expressing keen appreciation of the welcome accorded him.

Papers were read as follows:

"On the Action of Diazo Compounds upon Thymolparasulpho Acids," by J. H. Stebbins.

"Note on the Reichert Figure of Butter," by J. H. Stebbins.

"Some Facts and Fictions about Milk," by L. L. Van Slyke.

"Comparative Value of Certain Reagents for Removing Lime and Magnesia from Natural Waters for Industrial Uses," by Martin L. Griffin.

"A New Valve for Laboratory Apparatus," by C. F. McKenna.

DURAND WOODMAN, *Secretary.*

PHILADELPHIA SECTION.

The Philadelphia Section of the American Chemical Society was organized the evening of May 17, 1899, about fifteen members being present. Mr. W. H. Jayne, 931 N. Broad St., Philadelphia, was elected presiding officer and F. E. Dodge, 944 Drexel Building, Philadelphia, was elected secretary and treasurer. The following committee was appointed on by-laws: Dr. Matthews, Mr. Taggart, and Mr. Dodge.

The section adopted the third Thursday of each month, except July and August, for stated meetings of the section.

D. W. Harding read a paper on the "Derivatives of the Atomic Mass of Palladium."

F. E. DODGE, *Secretary.*

RHODE ISLAND SECTION.

The regular monthly meeting of the Rhode Island Section of the American Chemical Society was held at the Hope Club, Providence, April 27, 1899, with Mr. Edward D. Pearce as presiding officer.

After dinner, Mr. Charles A. Catlin of the Rumford Chemical Company, presented a paper on "Culinary Phosphates."

The reader referred briefly to the history of cooking, laying particular stress upon the early appreciation of the dietetic value of a light cellular structure in bread, with a very general reference to various ways and means adopted for its attainment, citing as one of the most efficient, the aeration of the dough through the evolution within it of carbon dioxide by chemical reaction between an alkaline bicarbonate and an acid or acid salt, and calling attention to the fact that it was as an agent in this latter operation that culinary phosphates play their part. The history of the culinary application of the phosphates is interesting. The peculiar behavior of phosphoric acid and its salts had been most perplexing. Graham's classic research in 1833 furnished a clearer conception of these and roused great interest in their study. Liebig pushing on in his brilliant career found them everywhere associated with life, and finally proved them essential to life of every form. Horsford, the pupil and assistant of Liebig, caught the inspiration of the master and finally his inventive genius suggested the employment of, in place of the questionable acids and acid salts used in connection with sodium bicarbonate as leavening agents, acid phosphate of calcium. It was many years however before careful research enabled him to present the article, under the name of cream of tartar substitute, in any reasonable commercial condition because of its extremely acid and deliquescent character. Finally the discovery of a process for the manufacture of monocalcic phosphate preparations without the deliquescent free phosphoric acid has so improved it that it has made a place for itself *per se* no longer as a substitute but standing by itself alone, now known as "phosphate acid." The reader called attention to the undesirable qualities of preparations of this kind wherein free phosphoric acid present induces too rapid evolution of the gas of the bicarbonate when mixed therewith in use, as well as to the

deliquescent property of such compound prohibiting their safe employment in baking-powders; gave methods also for the determination of these qualities exactly, calling attention to the uncertainties of estimations of value based wholly upon the titration with caustic alkali solutions, never having found in his experience of twenty-six years and the examination of many thousand samples, a single case wherein the equivalent sodium bicarbonate as shown by the titration process could be made to evolve its entire carbon dioxide under the conditions of the baking process, despite statements to the contrary based evidently upon purely theoretical considerations. Attention was called to the use of normal phosphoric acid solutions in indirect titration of such compounds. Attention was also called to the secondary reaction of monocalcic phosphate with sodium bicarbonate in presence of artificial hydrated calcium sulphate and showing its value in certain baking operations which, however, unrecognized by food inspectors is sometimes condemned as adulteration of terra alba. Manufacturers of monocalcic salts are often put to great expense and trouble to remove from their goods this incidental impurity which really in some kinds of baking work may be a valuable assistant.

Baking-powders in which monocalcic phosphate preparations are used, could formerly be presented commercially only in tightly sealed bottles; now, by reason of great advances, the manufacture of a monocalcic phosphate preparation without deliquescent properties has been attained, and the goods are sold in ordinary unsealed cans; these improved goods have perfect commercial stability.

The reader then gave methods for determining the relative commercial stability of baking-powders: Having determined in each the carbon dioxide content, weighed samples of the powders to be compared are exposed to the humid atmospheric influence obtained by suspending them over water under a bell glass, and the carbon dioxide determined in each after the same length of exposure, relative loss under same conditions and during exactly the same periods of time indicating relative stability. Attention was called to the fact that, not alone the amount of available carbon dioxide, but the conditions under which it was evolved, determined the leavening value of a baking-powder, and gave methods for the determination of these.

Finally particular attention was called to the usefulness of determination of the gravimetric density taken in connection with available carbon dioxide content in the valuation of a baking-powder. Domestic use of baking-powders is always by measure, never by weight. Experience has proved that the most efficient work in ordinary practice of cooking is obtained from a baking-powder capable of yielding about fifty times its

volume of available gas; very much more, or very much less than this in the ordinary cook's practice, yields poor results. Methods of arriving at a measure of the volumes of baking-powders and apparatus employed, were described. The most reliable commercial gravimetric density is that obtained through the volume of the powder as purchased in the can and the weight of the same. Other standards, such as per cent. by weight of available gas, for instance, are liable to be misleading.

WALTER E. SMITH, *Secretary.*

CHICAGO SECTION.

The 28th meeting of the Chicago Section was held at the Technical Club, Friday, April 28th, 1899.

Dr. J. H. Long gave a brief talk on "Oils," after which the section adjourned to the convenient laboratory of the Dearborn Drug and Chemical Co., 29 Rialto Building, where Mr. W. A. Converse described the physical testing of oils illustrating by a number of practical tests.

Prof. H. W. Wiley, of Washington, while in Chicago as an expert in the Pure Food Investigation, was given a dinner by the local section at the Technical Club, May 10, 1899. After the dinner, the members had the pleasure of listening to informal addresses from Prof. Wiley and from Mr. Wm. McMurtrie of the New York Section, who was also the guest of the club.

F. B. DAINS, *Secretary.*

Issued with July Number, 1899.

Proceedings.

COUNCIL.

NAME PROPOSED FOR MEMBERSHIP.

Mason, Francis Payne, 173 Broadway, Bangor, Me.

CHANGES OF ADDRESS.

Bassett, Geo. O., 30 Farnsworth St., So. Boston, Mass.
Beck, Oscar C., 383 1st St., Brooklyn, N. Y.
Cappon, Thomas W., 688 E. 139th St., N. Y. City.
Comey, Arthur M., 54 Concord Ave., Cambridge, Mass.
Eakins, L. G., care Phila. S. & R. Co., Pueblo, Colo.
Ellms, J. W., Lab. East Court & Market Sts., Cincinnati, O.
Folsom, Herbert A., Atlantic Mills, Providence, R. I.
Harding, Everhart P., Pension Villa Carola, 50 Leopold Strasse, Heidelberg, Germany.
Miller, S. C., 18 New York Ave., N. E., Washington, D. C.
Murrill, Paul I., Hickory, N. C.
Pierce, Edw. W., 109 N. Water St., Philadelphia, Pa.
Sanders, C. N., Box 273, Bristol, Va.-Tenn.
Schedler, R. W., 405 4th St., Brooklyn, N. Y.
Schleicher, F. J., 38 W. 10th St., Long Island City, N. Y.
Seal, A. N., 405 Wister St., Germantown, Philadelphia, Pa.
Smolt, F. O., 308 W. Broadway, New York City.
Stetson, Frank O., U. S. Weather Bureau, Washington, D. C.
Taylor, S. F., Box 513, Schoharie, N. Y.
Thatcher, R. W., 2949 Potter St., Lincoln, Nebr.
Tower, O. F., Southport, Conn.
Van Dyck, E. M., Bureau Engraving & Printing, Washington, D. C.

ADDRESSES WANTED.

Lockwood, Rhodes G., 118 Beacon St., Boston, Mass.
Jessurun, David, care of Minn. Beet-Sugar Mfg. Co., St. Louis Park, Minn.

NEW YORK SECTION.

A special meeting of the New York Section was held on Saturday, May 27th, at 8.45 P.M., Dr. Wm. McMurtrie presiding.

Dr. Doremus read a notice of the Fourth International Congress of Applied Chemistry to be held in Paris in 1900.

Dr. H. W. Wiley read a paper on "The Chemistry of Nitrification," illustrated by lantern slides.

The meeting was followed by refreshments under the auspices of the Chemists' Club, Dr. C. F. Chandler, its president, presiding.

M. T. BOGERT, *Secretary pro tem.*

The regular meeting of the New York Section was held on June 9th, at 8.30 P.M., in the Assembly Room of the Chemists' Club, Dr. Wm. McMurtrie presiding.

The following papers were read:

"Apparatus for Determining the Density of Cements," by Morris Loeb.

"The Determination of Sulphur in Bitumens," by S. F. and H. E. Peckham.

"Report of the Committee on Patent Legislation," by C. C. Parsons.

The election of officers of the section for the ensuing year resulted as follows:

Chairman.—E. F. McKenna.

Secretary-Treasurer.—Durand Woodman.

Executive Committee.—Wm. McMurtrie, E. G. Love, Geo. C. Stone.

Delegates to the Scientific Alliance.—E. E. Smith, Marston T. Bogert.

A unanimous vote of thanks was given to the retiring chairman for his untiring efforts and successful work.

The secretary reported that nine regular and two special meetings had been held with an average attendance of sixty-five members. Thirty-seven papers were presented and read during the season.

After the election, Dr. McKenna took the chair and made a short address expressing his appreciation of the compliment in electing him to the chair and promising to use his best efforts to maintain the high degree of interest and success achieved by his predecessor.

DURAND WOODMAN, *Secretary.*

Issued with August Number, 1899.

Proceedings.

COUNCIL.

Dr. A. P. Hallock's resignation from the finance committee was accepted May 26, and Mr. J. H. Wainwright was elected in his place June 22.

The Committee on Standards for Instruments of Measure has submitted the following report:

To the President and Members of the American Chemical Society:

Your committee, to which you have assigned the duty of making a study of the means by which the American Chemical Society can hasten the adoption of uniform systems of graduation, definite limits of accuracy, and standard methods for using all forms of measuring instruments employed in chemical laboratories, beg to make the following preliminary report:

The committee was promptly organized by correspondence after its members had been notified of their appointment by the proper officer of the Society. After much discussion the committee decided to take up first the consideration of the proper form, system of graduation, limits of accuracy, manner of labelling, and methods of using glass volumetric apparatus. The committee has made a careful study of the work that has already been done in other countries on the subject, an account of which is given on pp. 527–550 of this Journal.

Your committee accordingly submits the following recommendations for your consideration:

1. That the American Chemical Society, in a manner consistent with its constitution and by-laws, ask the U. S. Office of Weights and Measures to adopt regulations for the verification of volumetric apparatus which shall be similar in purpose and scope to the regulations of the Kaiserliche Normal-Aichungs-Commission, after due consideration of the criticisms to which the latter have been subjected.

2. That the U. S. Office of Weights and Measures be asked to give special consideration to the question of a standard tem-

perature or temperatures to be adopted for the graduation of volumetric apparatus, and to obtain as far as practicable an expression of opinion from American chemists on this point.

3. That the U. S. Office of Weights and Measures be asked to submit its regulations to the American Chemical Society, or a duly appointed committee thereof, for suggestions before final adoption by that office.

4. That the International kilogram be adopted as the standard of mass.

5. That the liter as defined by the International Committee on Weights and Measures, be adopted; *viz.*, the volume of the *mass* of a kilogram of pure water at the temperature of maximum density and under a pressure of 760 mm. of mercury.

6. That all density determinations be referred to water at its maximum density and under a pressure of 760 mm. of mercury.

7. That all temperatures be expressed in terms of the hydrogen thermometer of the International Bureau of Weights and Measures.

8. That if any question arise as to the interpretation of the above definitions, the decision and standards of the U. S. Office of Standard Weights and Measures shall be accepted by the Society as final.

E. E. Ewell, *Chairman.*
Louis A. Fischer.
H. P. Talbot.
C. E. Linebarger.
G. E. Barton.

April 13, 1899. *Committee.*

This report has been adopted by the Council, and the President has been authorized to make the formal requests of the U. S. Office of Weights and Measures recommended in the report.

NAMES PROPOSED FOR MEMBERSHIP.

Hand, W. F., Agricultural College, Miss.
Howell, E Vernon, Chapel Hill, N. C.
Meaker, W. Lathrop, Longdale, Va.

NAME PROPOSED FOR ASSOCIATE MEMBERSHIP.

Butler, Robert H., 406 E. Sandusky Ave., Bellefontaine, Ohio.

NEW MEMBERS ELECTED JULY 10, 1899.

Eckfeldt, Jacob B., U. S. Mint, Philadelphia, Pa.
Ellery, James B., 12 Ellsworth Ave., Cambridge, Mass.

Gifford, Wm. E., 69 6th St., Long Island City, N. Y.
Goldman, A., 45 Cedar St., New York City.
Griffith, Mary D., 3914 Walnut St., Philadelphia, Pa.
Heidenhain, Heinrich, Price Baking Powder Co., Michigan St. and Dearborn Ave., Chicago, Ill.
Hough, George J., 2235 Sheridan Pl., Evanston, Ill.
Lengfeld, Felix, University of Chicago, Chicago, Ill.
McClement, W. T., Armour Inst., Chicago, Ill.
Meyer, Frederick L., 2028 Park Ave., Philadelphia.
Miller, Armand R., 812 Euclid Ave., Kansas City, Mo.
Moore, Russell W., Appraiser's Stores, Washington and Christopher Sts., N. Y. City.
Newman, Jacob W., Empire Hotel, N. Y. City.
Perkins, Albert S., Dorchester High School, Boston, Mass.
Phinney, John I., Cambridge Latin School, Cambridge, Mass.
Schlichting, Emil, 61 Hicks St., Brooklyn, N. Y.
Tower, Olin F., Adelbert College, Cleveland, O.
Van Slyke, Lucius L., Expt. Station, Geneva, N. Y.
Williams, Lawrence S., Armour Inst., Chicago, Ill.
Woods, R. M., Plano Mfg. Co., West Pullman, Ill.

ASSOCIATES ELECTED JULY 10, 1899.

Allen, Lucius E., 213 E. Liberty St., Ann Arbor, Mich.
Semonite, R. G. C., 910A Green Ave., Brooklyn, N. Y.

CHANGES OF ADDRESS.

Appleton, H. A., 42 Crossfield St., Warrington, Lancashire, Eng.
Ashley, Harrison E., 947 Acushnet Ave., New Bedford, Mass.
Boot, J. C., Director of the Experimental Station of the Klattensche Cultuur Maatschappÿ in Klatten, Java, Dutch East Indies.
Brewer, Chas. E., 70 Huestis St., Ithaca, N. Y.
Coburn, Arthur S., 49 Oak St., Lowell, Mass.
Harris, Edward P., The Lakewood School, Lakewood, N. J.
Henderson, W. E., 41 W. 11th Ave., Columbus, Ohio.
Hewitt, Edward R., 119 E. 18th St., N. Y. City.
James, Joseph H., Washington C. H., Ohio.
Kelly, F. G., Henderson, N. C.
Lindauer, A. M., 3312 Calumet Ave., Chicago, Ill.
Liska, Anton, 1440 So. 4th Court, Chicago, Ill.
Mooers, Chas. A., care Agr. Expt. Sta., Knoxville, Tenn.
Nichols, H. T., Linares, S. José, N. Leon, Mexico.
Peckham, Stephen F., 54 Downing St., Brooklyn, N. Y.
Perry, Chas. M., 238 Cottage St., Pawtucket, R. I.
Prentice, W. P., 52 Broadway, N. Y. City.

Schoch, Eugene P., Kent Chem. Lab., Univ. of Chicago, Chicago, Ill.

Smolt, F. O., 308 W. Broadway, Butte, Mont.

Wentworth, W. V., care Penobscot Chem. Fibre Co., Great Works, Me.

Weston, Robert Spurr, 14 Beacon St., Boston, Mass.

Issued with September Number, 1899.

Proceedings.

COUNCIL.

NAMES PROPOSED FOR MEMBERSHIP.

Benton, S. Irving, 249 E. Logan Sq., Philadelphia, Pa.
Keller, Cornelius, La Gran Fundicion Central Mexicana, Aguas Calientes, Mexico.
Tuschka, Otto, La Gran Fundicion Central Mexicana, Aguas Calientes, Mexico.

CHANGES OF ADDRESS.

Acker, Charles E., cor. Third St. and Walnut Ave., Niagara Falls, N. Y.
Blair, A. W., Lake City, Fla.
Coburn, Arthur S., 49 Oak St., Lowell, Mass.
Hough, George J., Cerralbo, Nuevo Leon, Mexico.
Kilgore, B. W., Raleigh, N. C.
Mahon, R. W., 1778 Second Ave., Pittsburg, Pa.
Meyer, Gustav M., 59 E. 77th St., New York City.
Perry, Chas. M., 268 Cottage St., Pawtucket, R. I.
Sherman, H. C., Ash Grove, Virginia.

MEETINGS OF THE SECTIONS.

PHILADELPHIA SECTION.

The second meeting of this section was called to order in the Harrison Laboratory, University of Pennsylvania, at 8.15 P. M., June 8th., by the presiding officer, eleven members and visitors being present.

The minutes of the last meeting were read and approved. The secretary read a letter from the secretary of the American Chemical Society, calling attention to some changes in the list of members, and notifying us that the Philadelphia Section was entitled to one representative on the council.

The report of the By-Laws was read, accepted and adopted as a whole.

The secretary cast the ballot in the election of the following

officers: Mr. Taggart, Dr. Matthews, and Dr. Shinn as members of the Executive Committee, and Dr. John Marshall member of the council for the remainder of the current year.

The following papers were read:

"The Determination of Nickel in Nickel-Steel," by Geo. Wm. Sargent, Laboratory of the Carpenter Steel Co., Reading, Pa., read by the secretary.

A paper descriptive of a very compact apparatus for the analysis of illuminating and other gases, by Geo. E. Thomas.

"An Electrolytic Study of Benzoin and Benzil," by J. H. James, read by Dr. Hardin.

The meeting was adjourned at 9.40 P.M.

F. E. DODGE, *Secretary.*

Issued with October Number, 1899.

Proceedings.

NINETEENTH GENERAL MEETING OF THE AMERICAN CHEMICAL SOCIETY. MINUTES.

The nineteenth general meeting of the American Chemical Society was called to order at 11.30 A.M., August 21, 1899. The session was held in the chemical lecture room of Townshend Hall, at the Ohio State University, Columbus.

Minutes of the previous meeting, as recorded in the secretary's book, were approved.

The Committee on Coal Analysis made a final report through its chairman, William A. Noyes. The report was accepted and the committee discharged.

The final report of the Committee on Duty-free Importations was presented by Chas. E. Munroe, chairman. The society accepted the report and the committee was discharged.

The report of the Committee on Standards for Instruments of Measure was accepted as already printed in the Journal of the society.

A report of progress of the Committee on Patents and Related Legislation was presented by the chairman, Chas. E. Munroe, and upon motion was accepted by the society.

The Committee on Nomenclature and Spelling of the Journal had no report to present.

The secretary presented a brief, informal report, in which it was stated that the total membership of the society at present was 1,540, consisting of active members, 1,404, associates, 128, honorary members, 8.

Since the last meeting the society has lost by death the following named members: Chas. P. Worcester, Boston, Mass.; John R.

Wagner, Drifton, Pa.; C. F. Vanderford, Knoxville, Tenn.; Henry Trimble, Philadelphia, Pa.; and Thomas L. Blalock, Baltimore, Md.; also two honorary members: namely, Sir Edward Frankland, London, England, and Professor Robt. Wilhelm Eberhard Bunsen, Heidelberg, Germany.

Professor C. E. Munroe moved that the president appoint a committee to draw up a suitable memorial with reference to Sir Edward Frankland, and another committee to prepare a memorial with reference to Professor Bunsen. The motion was adopted.

After some announcements by the secretary and Professor Weber, the society adjourned to meet in Chemical Hall, at two o'clock in the afternoon.

AFTERNOON SESSION.

The society was called to order at 2.20 P.M., by President Morley. A paper on "The Relation of Physical Chemistry to Technical Chemistry," was presented by Wilder D. Bancroft, and discussed by Messrs. Hart, Wiley, Hale, Parsons, Kahlenberg, and C. B. Dudley. The next paper "On the Constitution of the Oxyazo Compounds," was presented by the author, William McPherson, and discussed by Messrs, Bancroft and McPherson. The next paper was "Upon the Nature of the Change from Violet to Green in Solutions of Chromium Salts," by W. R. Whitney. This was discussed by Messrs. Kahlenberg and Whitney. The afternoon session was then adjourned.

TUESDAY, AUGUST 22.

MORNING SESSION.

The society was called to order at 10.15 A.M., in the chemical lecture room at Townshend Hall. President Morley announced the following committees: on Frankland Memorial, Edgar F. Smith, William A. Noyes and Albert B. Prescott; on Bunsen Memorial, Albert C. Hale, W. F. Hillebrand and H. W. Wiley.

The secretary then read a paper "On the Analysis of Zinc for Cadmium and Lead," prepared by P. A. Mackay. This was followed by a paper "On the Electrolytic Deposition of Metals from Non-aqueous Solutions," by Louis Kahlenberg. This paper was discussed by Dr. Hart.

A report of progress of the Committee on Standards for Instruments of Measure, was read by the secretary in the absence of the chairman of the committee. The secretary also read a communication from Dr. C. A. Doremus, with reference to the proposed Fourth International Congress on Applied Chemistry, to be held in Paris, July 3 to 31, 1900.

After some announcements by the secretary and by Professor Weber, the society listened to an address entitled, "Some Experimental Illustrations of the Electrolytic Dissociation Theory," by Arthur A. Noyes. The address was fully illustrated by experiments.

President Morley announced that the council had decided to hold the winter meeting of the society in New Haven, Conn. He then declared the morning session adjourned.

AFTERNOON SESSION.

The first paper presented in the afternoon was upon the "Improvement in the Chemical Composition of the Corn Kernel," by C. G. Hopkins. This was discussed by Messrs. Weber, Wiley, Hale, Dudley, and Howard. The next paper was upon "Some New Products of Maize Stalks," by H. W. Wiley and W. H. Krug, read by Dr. Wiley. The secretary then read a paper on "The Chromic Acid Test for Cocaine," prepared by Geo. L. Schaefer.

Upon motion of Dr. Wiley, the thanks of the society were tendered to the Columbus Section of the American Chemical Society, the Local Committee of the American Association for the Advancement of Science, the faculty and trustees of the Ohio State University, and to Professor H. A. Weber, in particular, also to the citizens of Columbus generally, all of whom have been unsparing in their efforts to promote the interests of the nineteenth general meeting of the American Chemical Society and to give the visiting chemists a most cordial welcome and entertainment.

After a few announcements the president declared the nineteenth general meeting of the society adjourned.

ALBERT C. HALE, *Secretary.*

The Fourth International Congress of Applied Chemistry is to be held in Paris from the 23rd to the 31st of July, 1900, under

the patronage of the French Government, and the following named chemists as officers: Honorary President, M. Berthelot; President, M. H. Moissan; Secretary General, M. F. Dupont; Vice-presidents, MM. Durin, Deherain, Lindet, Gallois, Pellet.

The scope of the Congress can be judged from the titles of the sections. An American Committee on Organization has been formed consisting of

Section I. Analytical Chemistry.

W. L. Dudley, W. F. Hillebrand, J. H. Long, Elwyn Waller.

Section II. Inorganic Products.

Edward Hart, Edward W. Morley, J. D. Pennock.

Section III. Metallurgy, Mines, Explosives.

F. W. Clarke, C. B. Dudley, C. E. Munroe, H. H. Nicholson.

Section IV. Organic Products.

Thomas Evans, Wm. McMurtrie, Ira Remsen, Clifford Richardson, S. P. Sadtler.

Section V. Sugar Industry.

Edward Gudeman, W. D. Horne, G. L. Spencer, M. Swenson, Edward B. Voorhees.

Section VI. Fermentations.

C. A. Crampton, W. B. Rising, Alfred Springer.

Section VII. Agricultural Chemistry, Fertilizers, Cattle Feeding, Dairy.

G. C. Caldwell, L. L. Van Slyke, H. W. Wiley.

Section VIII. Hygiene, Medical and Pharmaceutical Chemistry.

W. O. Atwater, R. H. Chittenden, J. U. Lloyd, Wm. P. Mason, Wm. J. Schieffelin.

Section IX. Photography.

C. F. Chandler, J. H. Stebbins, Jr., E. R. Hewitt.

Section X. Electrochemistry.

Elihu Thomson, Edgar F. Smith, Charles A. Doremus, *Chairman.*

It is hoped that chemists will follow the example of these gentlemen and subscribe to the Congress. The subscription entitles the member to the printed proceedings which are voluminous.

Since British chemists will take an active part in the Congress, notably the Society of Chemical Industry, it behooves all who can, to contribute papers, as well as to otherwise advance the interests of the Congress.

The fee for membership is twenty francs, and may be forwarded to M. F. Dupont, Secretary General, 156 Boulevard de Magenta, Paris, France, or to Dr. Charles A. Doremus, 17 Lexington Avenue, New York City, who, as Chairman of the American Committee, will forward the same and also give further information when so requested.

COUNCIL.

The council of the American Chemical Society met in Room 200, of the Chittenden Hotel, Columbus, Ohio, at 7 P.M., August 21, 1899.

There were present the following named councilors: E. W. Morley, Albert C. Hale, Edward Hart, H. W. Wiley, W. A. Noyes, Chas. Baskerville, J. H. Long, N. W. Lord, C. E. Munroe, Edgar F. Smith, W. F. Hillebrand, John Marshall, G. C. Caldwell, A. A. Noyes, C. B. Dudley, and A. B. Prescott.

The following resolutions were adopted:

1. *Resolved*, That the dues for membership for the year 1900 shall be collected by the secretary, as in the current year, and he shall be allowed ten per cent. on all collections as compensation for his work.

2. *Resolved*, That monthly bills presented by the secretary for clerical help during the year 1900 shall be approved by the Finance Committee, and paid by the treasurer of the society, provided that the total sum called for by said bills shall not exceed $600.

3. *Resolved*, That all persons whose nominations to membership shall have been received before the close of the nineteenth general meeting of the society are herewith passed upon by the council, and the secretary shall declare them elected to membership whenever all other requirements of the constitution regarding them as nominees to membership shall have been fulfilled.

4. *Resolved* That the editor's salary for the year 1900 be fixed at $250.

5. *Resolved*, That the council recommend the appropriation of $200 for the treasurer of the society during the year 1900.

6. *Resolved*, That the report of Dr. McKenna, as retiring treasurer, be printed in the Journal of the society.

7. *Resolved*, That the council herewith accepts the cordial invitation of the president and members of the faculty of Yale University, the director of the Sheffield Scientific School, and other professors of that institution and the Agricultural College to hold the winter meeting of the society in New Haven, Conn., during the last week in December, the exact date of said meeting to be fixed by the president and secretary of the society.

8. *Resolved*, That the resignation of Professor A. H. Sabin, as a member of the Finance Committee, be accepted, and that Dr. Wm. McMurtrie be herewith appointed to succeed Professor Sabin as member of said committee.

9. *Resolved*, That the council recommend to the Committee on Advertising that the entire business management of the advertising in the Journal during the remainder of the calendar year be intrusted to Dr. William McMurtrie, chairman of the Advertising Committee.

10. The report of the Committee on Foreign Postage was accepted and the committee discharged.

11. The report of the Committee on Life Membership Fund, announcing the permanent investment of funds sufficient to cover all life membership receipts up to date, was accepted, and the committee was discharged.

12. The report of the Committee on Exchanges was accepted, and the committee was discharged.

13. Upon motion, properly seconded and carried, the council appointed the following named persons as a standing Committee on Exchanges: Dr. H. C. Bolton, Washington, D. C., the editor and the librarian.

14. The Committee on Abstracts and Reviews presented a report of progress which was accepted.

15. The committee, appointed to consider and report upon appropriations for the library, presented a report, and after some discussion it was voted that the whole matter be referred back to said committee for further consideration and subsequent report.

16. The following motion of the acting librarian, Professor A. A. Breneman, was adopted, "Claims for non-receipt of the Journal from members, or subscribers, must be made within sixty days from the first day of the month corresponding to the missing number of the Journal."

17. Dr. Edgar F. Smith presented his resignation as member of the Committee on Papers and Publications. A motion to accept the resignation was defeated by unanimous vote.

18. The committee appointed to make recommendations regarding the reorganization and enlargement of the Committee on Papers and Publications, presented a report upon the subject, which had been referred back to said committee for further consideration.

19. After considerable discussion it was voted,

(1) That the Committee on Papers and Publications shall consist of nine members in addition to the editor, so chosen as to include representatives of each of the more important subdivisions of chemistry.

(2) That the subdivisions represented in said committee shall be the following: Inorganic Chemistry, Organic Chemistry, Analytical Chemistry, Physical Chemistry, Physiological Chemistry, Agricultural Chemistry, Industrial Chemistry, Mineralogical and Geological Chemistry, and Electrochemistry.

(3) That no specific divisions of the subject be announced in the publication of the committee.

(4) That each and every paper submitted for publication by the society shall be referred by the editor to that member of the committee, who, in his judgment, is best fitted to decide upon its merits, and he shall, jointly with the editor, decide finally in regard to its publication; provided, that in case of disagreement between the editor and said member, the paper shall be submitted to the president of the society for his decision.

(5) That we declare elected as members of the reorganized Committee on Papers and Publications the two present members of the committee, that is, Edgar F. Smith and John H. Long.[1]

[1] Note. The remaining members of the Committee on Papers and Publications will be elected by the council through correspondence.

20. The following motion, presented by W. A. Noyes, was adopted. "It is hereby moved that the publication of names of nominees for membership in the Journal shall be considered as a notification from the secretary to the council, and that, two weeks after such publication, the secretary shall cast the ballot of the council for nominees in such list against whom no objection has been raised."

21. The following motion, presented by C. E. Munroe, was adopted, "Whereas, it is the custom for financial officers of societies to be bonded, it is hereby ordered that the treasurer of the American Chemical Society be requested by the directors to give a bond of $5,000 on a surety company, which shall be renewed each year, the fee for this bond to be paid by the society."

22. Upon motion, properly seconded, and carried, it was ordered that the directors be requested to sell the invested funds of the society, other than the life membership fund, and to turn the proceeds into the treasury.

23. It was decided that the Committee on Papers and Publications be authorized to increase the October, November, and December numbers of the Journal for the current year, each to one hundred and fifty pages if found necessary.

24. Upon motion of Dr. Hart, the following suggestions made by Dr. Baskerville, were referred to a committee of three for consideration and recommendation, the committee to be appointed by the president. "I would suggest that on account of the twenty-fifth anniversary of the establishment of the society, a medal be given to that chemist who, in the opinion of the council, has made the most valuable contribution to chemical knowledge during the current year, and further that the medal be called the Priestley medal." President Morley appointed the following named persons to consider and report upon Dr. Baskerville's suggestion: Chas. E. Munroe, Albert B. Prescott, and J. W. Mallet.

ALBERT C. HALE,
Secretary.

TREASURER'S REPORT FROM DECEMBER 23, 1898, TO MAY 1, 1899.

REVENUE AND EXPENDITURES.

DR.

To Journal (5 Nos.)		$1,591.88
" Secretary's office		647.76
" Librarian's "		93.85
" Treasurer's "		55.50
" Editor's "		47.17
" General expense		19.30
" Expenses of N. Y. meeting		9.60
" Reprinting Journal		115.50
" Authors' reprints		113.82
" Review of American Chemical Research		49.35
To Local Sections :		
New York	$203.84	
Washington	100.00	
North Eastern	318.33	
Rhode Island	25.00	
Nebraska	30.00	
North Carolina	21.66	
Lehigh Valley	10.00	
		$708.83
To Commissions to secretary		587.50
" Life membership investment fund		1,300.00
" Renewal of library, new stacks, etc		446.82
" Balance in bank	877.68	
" Cash in treasurer's hands	5.00	882.68
		$6,669.56

CR.

By Balance on hand Dec. 23, 1898	13.29
" Dues collected by secretary	5,875.00
" Subscriptions	538.27
" Advertisements through Chemical Publishing Co	108.00
" Interest on special investment	35.00
" Life membership, Charles E. Munroe	100.00
	$6,669.56

CONDENSED REPORT OF THE OPERATIONS OF THE TREASURY FROM JANUARY 1, 1892 TO MAY 1, 1899.

Received from	Treasurer F. T. King, Jan. 1,	1892,	$	275.84
"	" other sources	1892,		1,887.82
"	" all "	1893,		2,662.93
"	" " "	1894,		4,502.39
"	" " "	1895,		5,216.02
"	" " "	1896,		5,339.99
"	" " "	1897,		5,976.48
"	" " "	1898,		8,122.74
"	" " "	to May 1, 1899,		6,656.27
				$40,640.48

Disbursements as per vouchers	1892,	$1,645.25
" " " "	1893,	3,107.29
" " " "	1894,	4,070.49
" " " "	1895,	4,722.89
" " " "	1896,	5,321.38
" " " "	1897,	6,172.10
" " " "	1898,	8,931.52
" " " " to May 1,	1899,	5,786.88
Balance to Treasurer A. P. Hallock		882.68
		$40,640.48

ASSETS AND LIABILITIES.

DR.

To American Chemical Society	$6,616.57
	$6,616.57

CR.

By special investment fund		$2,132.50
$2000 City of N. Y. 3½ % gold bonds, due 1915		
" Life membership fund		1,300.00
$1000 N. Y. City 3½ % gold bond, due 1928	$1,116.98	
Deposited in Em. Ind. Savings Bank	183.02	
By Uncollected accounts (editor's office)		1,123.79
" " " (secretary's office)		1,850.00
" Cash in editor's hands		65.97
" " " secretary's hands		144.31
		$6,616.57

NEW YORK, May 1, 1899. CHAS. F. MCKENNA, *Treasurer.*

Insurance on library $5,000.

No bills remain unpaid. The library and stock of journals do not appear in above schedule because they have not yet been appraised. The securities have been examined and we certify that they are deposited in the vaults of the Mercantile Safe Deposit Company in this city.

The accounts of the treasurer since 1892 as set forth above have been examined, together with the books, vouchers, and securities and all have been found correct, E. & O. E.

ELWYN WALLER,
A. H. SABIN,
A. P. HALLOCK,
Finance Committee.

NEW YORK, May 1, 1899.

Transcribed from Vol. XIV, No. 1, p. 3.

ASSETS AND LIABILITIES. DECEMBER 31, 1891.

DR.

Cash in treasury	$275.84
Accounts 1890	254.20
Dues	35.00
Personal accounts	166.31
	$731.35

CR.

Subscriptions, Journal	$ 39.08
Back numbers, Journal	12.60
Dues and initiation fees	465.13
Personal accounts	20.17
American Chemical Society	194.37
	$731.35

NAMES PROPOSED FOR MEMBERSHIP.

Atkinson, Elizabeth A., 4109 Locust St., Phila., Pa.
Bernhard, Adolph, Stone Creek, O.
Blackshear, Charles C., Woman's College, Baltimore, Md.
Chamberlain, Joseph S., Oberlin, O.
Cox, John S., Lacka. I. and S. Co., Scranton, Pa.
Fischer, Robert, 810 Franklin Ave., Columbus, O.
Garrigues, W. E., Loomis, Wash.
Johnson, F. C., 714 Union St., New Orleans, La.
Oglesby, Wm. R., 212 E. Broad St., Chester, Pa.
Sarles, Edgar H., Stelton, N. J.
Saunders, A. P., Experimental Farm, Ottawa, Canada.
Schoonmaker, H., 124 South Main St., Los Angeles, Cal.
Shuttleworth, Arthur E., Guelph, York Co., Ontario, Canada.
Worstall, Robert A., Purdue Univ., Lafayette, Ind.

CHANGES OF ADDRESS.

Asbury, S. E., Dept. of Agr., Raleigh, N. C.
Avery, Samuel, Univ. of Idaho, Moscow, Idaho.
Blanchard, Arthur A., Mass. Inst. Tech., Boston, Mass.
Browne, Arthur B., Bearmouth, Mont.
Closson, C. D., Box 552, Bisbee, Ariz.
Davoll, David L., Jr., Peninsular Sugar Ref'g Co., Caro, Mich.
Edgerly, D. W., care of Chilton Paint Co., College Point, N.Y.
Guiterman, Franklin, Amer. Sm. and Ref. Co., Pueblo, Colo.
Jameson, A. H., Phoenixville, Pa.
Kelly, Wm. E., 262 Fifth ave., N. Y. City.

Keiser, E. H., Washington Univ., St. Louis, Mo.
Lenher, Victor, Columbia Univ., N. Y. City.
Murrill, Paul, 804 Monroe St., Ann Arbor, Mich.
Peppel, S. V., 215 Murray St., Madison, Wis.
Redding, C. R., Index, Snohomish Co., Wash.
Roller, H. C., care of Dick, Ridout & Co., Cobourg, Ontario, Canada.
Sherman, H. C., Columbia Univ., N. Y. City.
Smith, H. Monmouth, Univ. of Syracuse, Syracuse, N. Y.
Tower, O. F., Adelbert College, Cleveland, Ohio.
Walter, Chas. A., care of McCoy Howe Co., 129 W. Georgia St., Indianapolis, Ind.

ADDRESSES WANTED.

Evans, Thos., formerly of Univ. of Cinn., Cincinnati, Ohio.
Robeson, A. M., formerly of 371 W. 120th st., N. Y. City.

Issued with November Number, 1899.

Proceedings.

BOARD OF DIRECTORS.

A meeting of the Board of Directors of the American Chemical Society was held at the Chemists' Club, New York, Friday, September 22, 1899. The following named directors were present: Messrs. McMurtrie, Doremus, Hallock, and Hale. Letters of regret for absence were received from President E. W. Morley and Dr. C. B. Dudley.

The meeting was called to order by the secretary at 8.10 P.M., and upon motion of Dr. Hallock, Dr. Wm. McMurtrie was chosen chairman *pro tem.*

Upon motion of Dr. Doremus it was ordered that the treasurer of the society be authorized and directed to pay, during the year 1900, the following sums as recommended by the council:

(1) To the secretary, ten per cent. as commission upon all dues collected by him during the year 1900.

(2) To the secretary, monthly bills for clerical help presented by him provided the total sum called for in such bills shall not exceed $600 during the year 1900.

(3) To the editor, $250 for salary.

(4) To the treasurer, $200.

It was voted that the action of the council in the following cases be ratified and approved:

(1) That the Committee on Papers and Publications be authorized to increase the October, November, and December numbers of the Journal for the current year to 150 pages each, if found necessary.

(2) That it be recommended to the Committee on Advertising that the entire business management of the advertising in the Journal during the remainder of the calendar year be entrusted to Dr. Wm. McMurtrie, chairman of the Advertising Committee.

(3) That the treasurer of the society be requested to give a bond of $5,000 on a surety company, which shall be renewed each year, the fee for the bond to be paid by the society.

The following preambles and resolutions were adopted:

WHEREAS, The council has requested that the directors shall sell the invested funds of the society, other than the life membership fund, and turn the proceeds into the treasury; and

WHEREAS, After careful consideration, the directors have found that there is a considerable amount of available assets as shown by the accounts of the treasurer, therefore

Resolved, That the treasurer be directed to make every effort to realize upon these available assets before any sale of invested funds shall be considered.

The meeting then adjourned, subject to the call of the secretary.

ALBERT C. HALE, *Secretary*.

COUNCIL.

NAMES PROPOSED FOR MEMBERSHIP.

Bregowsky, Ivan M., care Crane Co., 52 Judd St., Chicago, Ill.

Carr, Louis B., Ouray, Colo.

Coit, James M., St. Paul's School, Concord, N. H.

Corse, Wm. M., 3553 Bogart Ave., Avondale, Cincinnati, Ohio.

Fogetty, Lucien, care Andrew Jorgens & Co., Spring Grove Ave., Cincinnati, Ohio.

Getz, Wm. H., 2087 Harrison Ave., Cincinnati, Ohio.

Gibson, Harriet Winfield, 77 Washington Ave., Newark, N. J.

Gore, Chas. Herbert, Ohio State Univ., Columbus, Ohio.

Hanson, Charles A., care Fleischmann & Co., Riverside, Cincinnati, Ohio.

Harrold, Ernest E., 169 King Ave., Columbus, Ohio.

Hartman, William Everett, 843 Lafayette Ave., Detroit, Mich.

Kohr, Donald A., Ohio State Univ., Columbus, Ohio.

Mudge, Charles W., 76 Brook St., Geneva, N. Y.

Peppel, Samuel V., Univ. of Wisconsin, Madison, Wis.

Sticht, G. A. H., care Tartar Chemical Co., 9th St. and Gowanus Canal, Brooklyn, N. Y.

Swan, Clifford N., Brookline, Mass.

Zimmele, H. B., 465 W. Broadway, N. Y. City.

NAMES PROPOSED FOR ASSOCIATE MEMBERSHIP.

Grayson, Wm., Jr., 702 S. University Ave., Ann Arbor, Mich.

Watson, Henry E. G., Lafayette College, Easton, Pa.

CHANGES OF ADDRESS.

Allen, L. E., 215 E. Liberty St., Ann Arbor, Mich.
Ashley, Harrison E., 42 Rutland Sq., Boston, Mass.
Baxter, Gregory P., Haverford College, Haverford, Pa.
Burt, M. C., Penna. Military College, Chester, Pa.
Clark, Edmund, 105 Beech St., Flushing, N. Y.
Coggeshall, G. W., 11 Prescott Hall, Cambridge, Mass.
Ellery, James B., 322 Pine St., Steelton, Pa.
Flynn, O. R., 6617 Drexel Ave., Chicago, Ill.
Fosdick, E. H., Prospect Park, Cal.
Franklin, Arthur I., 100 Canal St., Cleveland, O.
Given, Arthur, 793 Milbury St., Worcester, Mass.
Granja, Rafael, care Pelgram and Meyer, Paterson, N. J.
Hayes-Campbell, J., Cave Spring, Ga.
Labonde, Leon, Los Angeles, Cal.
Lipman, J. G., 312 Farm St., Ithaca, N. Y.
Merigold, B. S., 1691 Cambridge St., Cambridge, Mass.
Pemberton, H., Jr., 1008 Clinton St., Philadelphia, Pa.
Pickert, L. W., Amer. Sugar Ref. Co., Granite St., Boston, Mass.
Sanders, C. N., Buena Vista, Va.
Taylor, S. F., 3134 Boulevard, N. Y. City.
Thatcher, Chas. J., care B. T. Babbitt, 82 Washington St., N. Y. City.
Walker, Percy H., care Brown & Walker, 36 Cole Building, Nashville, Tenn.
Wilson, Edwards F., Box 291, Bristol, Tenn.

MEETINGS OF THE SECTIONS.

WASHINGTON SECTION.

The regular meeting of the Washington Section was held May 11, 1899. The first paper of the evening was read by F. W. Clarke, and was entitled "Experiments on the Constitution of Certain Silicates," by F. W. Clarke and George Steiger.

The paper cited some results obtained by Clarke and Schneider in 1889–92. The present work led to the following conclusions:

1. That pectolite is a metasilicate.

2. That the formula for pyrophyllite is possibly that of a basic dimetasilicate.

3. That calamine is probably a basic metasilicate which is in accord with the accepted formula.

With analcite a very interesting ammonia compound was formed, by heating with ammonium chloride. Other experiments agreed closely with those made by Friedel, and it was concluded that this mineral is a mixture of ortho- and trisilicates.

The last paper of the evening was read by Dr. H. N. Stokes, and was entitled "Indexing Organic Compounds."

Mr. Chestnut exhibited utensils used by the Indian women in the preparation of acorn meal. WILLIAM H. KRUG, *Secretary.*

RHODE ISLAND SECTION.

The annual meeting of the Rhode Island Section of the American Chemical Society was held at the Squantum Club, June 15, 1899, with Mr. Edward D. Pearce as presiding officer.

The following officers were elected for the year 1899–1900: Edward D. Pearce, President; Walter E. Smith, Secretary and Treasurer; Charles S. Bush, member of the Executive Committee.

After dinner the presiding officer, Mr. Edward D. Pearce, read a paper on "Hydrometers." A paper on "Chemical Detection of Vegetable Fibers," received from Mr. Edm. Jandrier, was also presented. WALTER E. SMITH, *Secretary.*

PHILADELPHIA SECTION.

The meeting was called to order at 8.20 P.M., September 22, 1899, in the Harrison Laboratory, University of Pa., the presiding officer in the chair. Fourteen members were present.

The secretary read the minutes of the last meeting; they were approved. The secretary stated that the New York Section of the American Chemical Society had invited the Philadelphia and LehighValley Sections to meet with them on a date to be fixed.

Dr. Smith gave a very interesting report of the summer meeting of the society in Columbus, Ohio, at the request of Dr. John Marshall, councilor representing this section, who was detained on a previous engagement and was unable to be present.

The following papers were read: "On the Persulphates of Rubidium, Cesium, and Thallium," by Arnott R. Foster and Edgar F. Smith; read by Dr. Smith. "The Precipitation of Copper by Zinc," by John C. Shengle and Edgar F. Smith; read by Dr. Smith. "Action of Hydrochloric Acid Gas upon Sulphates, Selenates, Tellurates, and Phosphates," by Raymond W. Tunnell and Edgar F. Smith; read by Dr. Smith. The last paper was discussed by Drs. Meeker and Bradbury.

There being no further business, the meeting adjourned at 9.15 P.M. F. E. DODGE, *Secretary.*

Issued with December Number, 1899.

Proceedings.

BOARD OF DIRECTORS.

An adjourned meeting of the Directors of the American Chemical Society, was held at the Chemists' Club, 108 W. 55th St., New York City, Nov. 10, 1899. There were present Directors Doremus, Hale, Hallock, and McMurtrie. Letters of regret for absence were received from President Morley, Dr. Chandler, and Dr. Dudley.

The meeting was called to order by the secretary at 9.35 P.M. and, upon motion of Dr. Doremus, Dr. Wm. McMurtrie was chosen temporary chairman. The minutes of previous meetings, as printed in the Journal of the Society, were approved. After some statements regarding the financial condition of the Society made by the treasurer and the secretary the following resolution was unanimously adopted, having been presented by Dr. Doremus and seconded by Dr. Hale:

"*Resolved*, That the Treasurer of the American Chemical Society is hereby authorized, in harmony with the recommendation of the council to the directors, to negotiate a loan of twelve hundred dollars ($1,200.00) for four months, and to sign a note for the Society, giving the two thousand dollar ($2,000.00) bond owned by the Society as collateral."

The meeting was then adjourned.

ALBERT C. HALE, *Secretary*.

COUNCIL.

The council has approved the formation of a local section to be known as the Michigan Section with territory consisting of the State of Michigan, and with headquarters at the University of Michigan, Ann Arbor.

The Committee on Papers and Publications has been finally constituted by the council as follows:

Edward Hart, *Editor*,
W. F. Hillebrand.
John H. Long,
William McMurtrie,
Arthur A. Noyes,
William A. Noyes,
Edgar F. Smith,
H. N. Stokes,
H. P. Talbot,
H. W. Wiley,

NAMES PROPOSED FOR MEMBERSHIP.

Adams, Walter O., 1776 Massachusetts Ave., No. Cambridge, Mass.
Ayer, Harold, Mass. Inst. Tech., Boston, Mass.
Baldwin, Charles E., 197 Auburn St., Cambridge, Mass.
Baldwin, De Forest, Kent Chem. Lab., New Haven, Conn.
Barnes, Bayard, Yale Univ., New Haven, Conn.
Beans, Hal T., Univ. of Nebr., Lincoln, Nebr.
Beck, Oscar C., 383 First St., Brooklyn, N. Y.
Boggs, Gilbert H., 603 S. 42nd St., Philadelphia.
Boltwood, Bertram B., Sheffield Scientific School, New Haven, Conn.
Boroschek, Leopold, 149 E. 56th St., New York City.
Breer, Louis B., Builders' Iron Foundry, Providence, R. I.
Button, Ok, Box 233, Trenton, Mich.
Casamajor, Walter, 372 Greene Ave., Brooklyn, N. Y.
Chase, March F., Mineral Point Zinc Co., Mineral Point, Wis.
Cluff, C. B., Lowell Textile School, Lowell, Mass.
Crofton, Alfred C., Vandervort Block, Pasadena, Cal.
Cross, Walter Martin, 12th and Troost Sts., Kansas City, Mo.
Cuadrado, Gaston A., Habana, Cuba.
Denham, Henry H., 146 N. Pearl St., Buffalo, N. Y.
Doolittle, R. E., Mich. State Dairy and Food Commission, Lansing, Mich.
Dustin, Guy K., 51 Prospect St., New Haven, Conn.
Fisher, Henry, 108 E. 70th St., N. Y. City.
Gerlach, Oscar, Mich. Cement Co., Coldwater, Mich.
Green, Erik H., 112 Newbury St., Boston, Mass.
Grosse, S. P., 180 6th Ave., Brooklyn, N. Y.
Hamilton Louis P., 3417 Hamilton St., Philadelphia.
Herger, Charles G., 11 Putnam St., Buffalo, N. Y.
Hopkins, Arthur J., Amherst, Mass.
Jackson, Florence, Wellesley College, Wellesley, Mass.
Johnson, Treat B., 141 College St., New Haven, Conn.
Knapp, Rudolf E., Parke Davis & Co., Detroit, Mich.
Kneeland, Frederick R., 239 W. 74th St., N. Y. City.
Lichtenstein, Alfred F., 134 Amity St., Brooklyn, N. Y.

Locke, James, Sheffield Chem. Lab., New Haven, Conn.
Loew, Oscar, U. S. Dept. of Agr., Washington, D. C.
Manteuffel, Adolf, Somerset Chem. Co., Bound Brook, N. J.
Meyer, Gustave M., 59 E. 77th St., N. Y. City.
Mixter, William E., Yale Univ., New Haven, Conn.
Moore, F. J., Mass. Inst. Tech., Boston, Mass.
Munson, L. S., Dept. of Agr., Washington, D. C.
Mc Farland, B. W., 278 Canner St., New Haven, Conn.
Newton, Elmer S., 3018 Cambridge Place, Washington, D. C.
Norman, George N., South Works Lab., Ill. Steel Co., Chicago, Ill.
Olshausen, Bruno, Stanford Univ., Cal.
Peet, B. W., Ypsilanti, Mich.
Parker, C. Le Roy, Patent Office, Washington, D. C.
Pemberton, Ralph, 1947 Locust St., Philadelphia, Pa.
Phalen, William C., New Mexico Sch. of Mines, Socorro, N. M.
Phelps, Isaac K., Kent Chem. Lab., New Haven, Conn.
Platt, Elbert S., Waterford, N. Y.
Post, Frank I., 243 E. 76th St., Chicago, Ill.
Shilestone, Herbert M., 114 Pearl St., N. Y. City.
Skinner, Hervey J., 15 Chestnut St., Wakefield, Mass.
Stead, John E., 11 Queen Terrace, Middlesbrough, Eng.
Sullivan, Eugene C., 331 Packard St., Ann Arbor, Mich.
Tucker, Charles W., 8 Grover St., Lynn, Mass.
Voorhees, Gerald E., Berwick, Pa.
Wachter, Leonard M., 45 James St., Green Island, N. Y.
Webb, Mr., 1256 Massachusetts Ave., Cambridge, Mass.
Wheeler, Henry L., Sheffield Chem. Lab., New Haven, Conn.
Wolf, Ernst, 214 E. 82nd St., N. Y. City.
Wright, Ralph G., 352 W. 115th St., N. Y. City.

NAMES PROPOSED FOR ASSOCIATE MEMBERSHIP.

Clark, Edwin H., 17 Hillhouse Ave., New Haven, Conn.
Gillet, Ransom H., Pafraets Dael Club, Troy, N. Y.
Goodenough, Robert J., 18 Seventh Ave., Brooklyn, N. Y.
Merriman, Henry F., Summit, N. J.
Mihalovitch, Sidney F., 829 Hutchins Ave., Avondale, Cincinnati, Ohio.
McCrudden, Francis H., 134 Castle St., Boston, Mass.
Rising, Herbert Robinson, 101 Wall St., New Haven, Conn.
Sullivan, Robert Barry, 111 Grove St., New Haven, Conn.
Swenarton, W. Hastings, 169 Union St., Montclair, N. Y.
Victor, Carl Louis, 101 Wall St., New Haven, Conn.

NEW MEMBERS ELECTED OCTOBER 14, 1899.

Atkinson, Elizabeth A., 4109 Locust St., Philadelphia, Pa.

Bernhard, Adolph, Stone Creek, O.
Chamberlain, Joseph S., Oberlin, O.
Cox, John S., Lacka. I. & S. Co., Scranton, Pa.
Fischer, Robert, 810 Franklin Ave., Columbus, O.
Oglesby, William R., 212 E. Broad St., Chester, Pa.
Sarles, Edgar H., Steelton, N. J.
Saunders, A. P., Experimental Farm, Ottawa, Canada.

NEW MEMBERS ELECTED OCTOBER 28, 1899.

Blackshear, Charles C., Woman's College, Baltimore, Md.
Garrigues, W. E., Loomis, Wash.
Shuttleworth, Arthur E., Guelph, York Co., Ontario.

NEW MEMBERS ELECTED NOVEMBER 15, 1899.

Bregowsky, Ivan M., Care Crane Co., 52 Judd St., Chicago, Ill.
Carr, Louis B., Ouray, Colo.
Coit, James M., St. Paul's School, Concord, N. H.
Corse, William Malcolm, 3553 Bogart Ave., Avondale, Cincinnati, O.
Getz, William H., 2087 Harrison Ave., Cincinnati, O.
Gibson, Harriet W., 77 Washington Ave., Newark, N. J.
Gore, Charles H., Ohio State Univ., Columbus, O.
Hanson, Charles A., care Fleischmann & Co., Riverside, Cincinnati, O.
Harold, Ernst E., 169 King Ave., Columbus, O.
Hartman, Wm. E., 843 Lafayette Ave., Detroit, Mich.
Kohr, Donald A., Ohio State Univ., Columbus, O.
Mudge, Charles W., N. Y. State Agr. Exp. Station, Geneva, N. Y.
Peppel, Samuel V., Univ. of Wis., Madison, Wis.
Sticht, G. A. H., care Tartar Chemical Co., 9th St. and Gowanus Canal, Brooklyn, N. Y.
Swan, Clifford N., Brookline, Mass.
Zimmele, H. B., 465 West Broadway, N. Y. City.

ASSOCIATES ELECTED NOVEMBER 15, 1899.

Grayson, William, Jr., 702 S. University Ave., Ann Arbor, Mich.
Watson, Henry E. G., Lafayette College, Easton, Pa.

CHANGES OF ADDRESS.

Barrett, J. M., 908 S. 5th St., East Cedar Rapids, Iowa.
Beck, Oscar C., Box 5, High Bridge, N. J.
Busby, Fred E., Mass. Inst. Tech., Boston, Mass.
Conner, Samuel D., Expt. Station, Lafayette, Ind.
Eberman, W. S., Encampment, Wyoming.

Ewell, E. E., 1804 S. St., N. W., Washington, D. C.
Gallaher, Philip C., 120 W. 6th St., Leadville, Colo.
Goodrich, Arthur L., 2103 Baronne St., New Orleans, La.
Horsford, Roger F., 30 Farnsworth St., Boston, Mass.
Kneeland, F. R., 56 W. 33rd St., N. Y. City.
Lerch, Fred, Virginia, Minn.
Linton, J. H., Birmingham, Ala.
Liska, Anton, 1510 S. 41st Ave., Chicago, Ill.
Lundteigen, A., Union City, Mich.
Mackay, P. A., Mineral Point Zinc Co., Mineral Point, Wis.
Magruder, E. W., Agricultural College, Miss.
Miller, Armand R., 808 Euclid Ave., Kansas City, Mo.
Miller, S. C., 1235 New York Ave., N. W., Washington, D. C.
Millwood, J. P., 177 Spence St., Brooklyn, N. Y.
Moody, Herbert R., 159 W. 105th St., N. Y. City.
McCandless, John M., State Chemist, Atlanta, Ga.
McCurdy, C. W., North Yakima, Wash.
McDonnell, M. E., Box 236, Altoona, Pa.
Neustadt, Geo. M. S., 234 E. 27th St., N. Y. City.
Nichols, Herbert T., care Puertocitos Copper Co., Bisbee, Ariz.
Norris, Albert P., 760 Massachusetts Ave., Cambridgeport, Mass.
Parks, R. M., Water Valley, Miss.
Payne, George F., Atlanta, Ga.
Peckham, Stephen F., 51 Quincy St., Brooklyn, N. Y.
Pullman, F. Cooper, 238 So. 3rd St., Philadelphia, Pa.
Rutherford, Forest, care La Gran Fundicion Central Mexicana, Aguas Calientes, Mexico.
Scudder, Heyward, Mass. Inst. Tech., Boston, Mass.
Shepard, C. H., 212 E. 25th St., Los Angeles, Cal.
Stiff, George, 439 Ditmar Ave., Borough of Queens, N. Y. City.
Thomas, N. Wiley, Room 330, City Hall, Philadelphia, Pa.
Tiffany, W. C., 21½ Spruce St., N. Y. City.
Taggart, Walter T., 730 N. 20th St., Philadelphia, Pa.
Tufts, J. L., General Chem. Co., Moro Phillips Works, 11th and Linden Sts., Camden, N. J.

ADDRESS WANTED.

Eustis, Allan C., formerly of 346 W. 58th St., N. Y. City.

MEETINGS OF THE SECTIONS.

PHILADELPHIA SECTION.

The meeting was called to order at 8.15 P.M., in the Harrison Laboratory, October 19, 1899, Chairman H. W. Jayne presiding. Twenty members were present. The minutes of the last meeting were read and approved.

The proposed joint meeting of the Lehigh, New York, and Philadelphia Sections to be held in New York City, was discussed, and it seemed to be the prevailing opinion that a date not earlier than the first of February, would be soon enough for the meeting.

Dr. J. Merritt Matthews, read a very interesting paper on "The Effect of Organic Radicals on the Color of Dye-stuffs."

Dr. G. W. Sargent gave a short note on "The Application of the Electric Spark to Carbon Determinations" and said that he hoped to have more to say upon this subject at a later date.

The meeting adjourned at 9.15 P.M.

The November meeting was called to order in the Harrison Laboratory, University of Pennsylvania, November 16, 1899, at 8.20 P.M., by the chairman, seventeen members being present.

The minutes of the last meeting were read and approved.

The chairman reported that the proposed joint meeting in New York had been postponed until later in the winter.

The next business being the election of a councilor it was moved, seconded, and carried that the nominations be made by acclamation. John Marshall was nominated, after which it was moved, seconded, and carried that nominations close. The secretary was instructed to cast the ballot for the nominee, who was declared elected member of council to represent this section for the term beginning January 1, 1900.

Robert Job presented a paper on "Some Causes of Excessive Friction in Bearing Metals," which he illustrated with numerous lantern slides, showing the defects of the metals as revealed by the microscope. The paper was discussed by Mr. Jones.

There being no further business, the meeting adjourned at 9.20 P.M.

F. E. DODGE, *Secretary.*

CINCINNATI SECTION.

The seventieth regular meeting took place in the Chemical Lecture Room of Hanna Hall, University of Cincinnati, on Saturday, October 14th, and was devoted to the presentation of the life work of the late Professor Bunsen. Twenty-one members were present, and President Simonson was in the chair.

After the transaction of regular business matters, papers were read by Mr. Stadermann, Prof. Hughes, Dr. Newman, and Mr. Weissmann respectively, on the contributions of Professor Bunsen to Physical, Inorganic, Organic, and Technical Chemistry. Dr. Springer and Prof. Norton then added some exceedingly interesting reminiscences of the personal side of this great chemist.

Mr. O. T. Joslin of the New York Section being present, upon request, gave a brief summary of the progress in the technical chemistry of animal products.

Upon motion, the meeting adjourned.

The seventy-first regular meeting was held on Wednesday, November 15th, in the Chemical Lecture Room of Hanna Hall, University of Cincinnati, twenty-two members being present, President Simonson in the chair.

Dr. Alfred Springer was reelected to represent the Cincinnati Section in the council for the year 1900.

Mr. E. Twitchell read an interesting paper on "Benzenestearosulphonic Acid and Related Compounds" (U. S. Patent No. 628,503), which was supplemented by some analytical notes on this subject by President Simonson. Mr. B. M. Pilhashy then read a short paper on "A Comparison of Some Formaldehyde Tests."

Upon motion, the meeting adjourned. S. WALDBOTT, *Secretary.*

NEW YORK SECTION.

The meeting was called to order by Chairman C. F. McKenna, at 8.25 P.M., October 6th, E. E. Smith, acting secretary, with fifty-nine members present. Total number in attendance was seventy-three.

The meeting opened with brief remarks by the chairman relative to the work of the section.

A paper entitled "Some Notes on the Year's Progress in Applied Chemistry" was presented by Wm. McMurtrie.

"Filters for Purifying Public Water Supplies," by Allen Hazen.

"The Mordanting and Dyeing of Silk," by Rafael Granja.

Discussion.—Dr. Bookman had found white spots on silk due to a fungus, which, however, did not grow on culture media. He had found that cells would absorb acids, contracting their outer layers. If placed in alkali, the acidity of the internal layers would gradually be reduced.

Next was presented a memorial tribute to Robert Wilhelm Eberhard Bunsen by former pupils, Dr. Doremus, Dr. Hodges, and Prof. Hale.

The chairman presented the subject of a joint meeting with the Philadelphia and Lehigh Valley Sections which had been considered by the Executive Committee. No action was taken.

Dr. Doremus asked for original contributions from members of the society to present at the Conference in Paris in August.

The meeting adjourned at 10.20.

E. E. SMITH, *Secretary pro tem.*

The regular meeting of the New York Section of the American Chemical Society was held in the Assembly Room of the Chemists' Club, 108 West 55th St., on Friday evening, November 10th. Sixty members were in attendance, Dr. C. F. McKenna, presiding. The following papers were read:

1. "Some Notes on the Year's Progress in Applied Chemistry," by Wm. McMurtrie.

2. "The Technical Analysis of Licorice Paste," by M. Trubek.

3. "On the Chemistry of Mucin," by P. A. Levene.

Dr. McMurtrie's continuation of his paper on "The Year's Progress in Applied Chemistry" was full of valuable material, and covered a wide range of subjects, among them the electrolytic production of alkali, the production of ozone on a large scale for bleaching oils and purification of water, improved shorter methods for manufacture of white lead, and a very full comparison of the efficiency of different gases and gas burners, as well as recent experimental work on the cause of light in the Welsbach mantle, and the best mixtures for the purpose.

The question of a joint meeting with the Philadelphia Section was brought up by the chair, who stated that it had been decided to postpone the proposed meeting until after the holidays.

DURAND WOODMAN, *Secretary.*

RHODE ISLAND SECTION.

The regular monthly meeting of the Rhode Island Section of the American Chemical Society was held October 19, 1899, at the Hope Club, 11 Benevolent St., Providence, R. I., with Mr. Edward D. Pearce as presiding officer.

Mr. Charles A. Catlin presented an informal address upon "Observations during a Recent Trip in Europe." His remarks were illustrated by two hundred and fifty pictures taken by himself during his travels.

The regular monthly meeting of the Rhode Island Section of the American Chemical Society was held November 16, 1899, at the Hope Club, Providence, R. I., with Mr. Edward D. Pearce as presiding officer.

After dinner, Prof. John H. Appleton, of Brown University, presented an address upon "Liquid Air." The speaker referred briefly to the history of progress in the liquefaction of gases, to the methods of preparing liquid air and to the proposed practical applications of the material.

WALTER E. SMITH, *Secretary.*

NORTH EASTERN SECTION.

The October meeting of the section was called to order at eight o'clock, on the evening of October 31st, in the Kidder Lecture Hall, of the Institute of Technology. There were about forty members present. After the reading and approval of the secretary's minutes, President Noyes introduced Professor A. H. Gill, who addressed the section on "Some Synthetic Oils." The composition and mode of manufacture of the oils were considered as well as the uses and values of the same. Dr. J. F. Norris then addressed the section on "Tellurium and the Periodic Law." In his address he called attention to the interest now centered about the determination of the atomic mass of tellurium especially in its relation to the periodic arrangement of the ele-

ments and described the various methods which have been, heretofore, employed to this end. He also described the work he has already done on tellurium, and the methods now to be employed in a further investigation of the subject.

Dr. Gill exhibited an ingenious adjustable ring devised by Rice and Buckminster, of Fitchburg, and designed to replace all the rings from one-half to five and one-half inches' diameter upon the usual ring stand.

The nominations of the Nominating Committee for officers of the section were received, and to the list several additional names were added from the floor. The election was postponed by unanimous vote until the November meeting.

W. R. WHITNEY, *Secretary.*

NORTH CAROLINA SECTION.

The summer meeting of the North Carolina Section was called to order by Dr. Baskerville, presiding officer, at 3 P.M., June 30, 1899, in the Lecture Room of the Chemical Division, University of North Carolina, Chapel Hill.

The secretary being absent, W. H. Pegram was appointed secretary *pro tem.*

The minutes of the annual meeting, February 11, 1899, were read and approved. Dr. Charles E. Munroe, ex-President American Chemical Society, was then introduced to the section.

Upon recommendation of the Membership Committee, the following were elected members of the section: S. E. Asbury, E. V. Howell, and B. W. Kilgore. The annual report of the secretary and treasurer was read and adopted.

The following papers were read and discussed:

"Analysis of Tennessee Phosphate Rock," by S. E. Asbury.

"Quantitative Electrolysis of Hydrochloric Acid," by J. M. Pickel.

"Absence of Solanin in the Tomato," by F. P. Venable and E. V. Howell.

"Secondary Heptylamine," by Thomas Clarke.

"Investigation of the Phenomena of Deliquescence and of the Capacity of Salts to Attract Water Vapor," by Charles R. Ely.

"On the Occurrence of Vanadium in Peat Ashes," by Charles Baskerville.

"On the Universal Distribution of Titanium," by Charles Baskerville.

"The Theory of Solutions," by W. H. Pegram.

"Condensation of Chloral with *o-p-m*-Nitranilines," by Charles Baskerville.

"The Value of Malonic Esters in Synthesis," by Thomas Clarke.

"Iron and Ammonium Chlorides," by F. P. Venable and F. W. Miller.

There being no further business the section adjourned.

W. H. PEGRAM, *Secretary pro tem.*

INDEX TO PROCEEDINGS.

ABSTRACTS, publication of 34, 35, 37, 45
Address, changes of 3, 26, 30, 40, 57
Addresses wanted 67, 86
Advertising in the Journal 80
Alloys, remarks on 46
Appleton, J. H. Some Elements Recently Announced, 6; Experimentation in Organic Chemistry 6
Applied chemistry, some notes on the year's progress 98
Ashes, determination of calcium and magnesium in 61
Atomic weights, international committee on 19
Atwater, W. O. Remarks on Calorimeter 44

BAKING powders, phosphate 64
Bearing metals, some causes of excessive friction in 96
Bogert, M. T. Resolutions on Acceptance of Resignation as Librarian 55
Boiling-point curves 4, 61
Bolton, H. C. The Classification of Chemistry Proposed by the International Committee of the Royal Society 61
Books, Library cards for new 45
Breneman, A. A. elected acting librarian 55
Bunsen, R. W. E., Committee to Prepare Memorial on 76
Butter-fat from milk, mechanical separation of 53
Button scale for use in blowpipe analysis 28

CAMERON, F. K. Some Boiling-point Curves for Mixtures of Miscible Liquids, 4; A Ternary Mixture, 4; See Means, T. H.
Calcium in ashes, determination of 61
Calorimeter, remarks on 44
Catalogue of the Royal Society, Classification of Chemical Titles for 61
Catlin, Charles A. Culinary Phosphates 64
Changes of address 3, 26, 30, 40, 50, 67, 71, 73, 85, 89
Chatard, T. M. Note on the Rate of loss in Cyanide Solutions 4
Cincinnati Section 7, 27, 43, 53, 62
Chemists' Club of New York, organization of, 7; library housed by 13
Chicago Section 8, 31, 50, 66
Clarke, F. W., and George Steiger. Experiments on the Constitution of Certain Silicates 89
Classification of chemical titles 61
Columbus meeting, minutes of 75
Columbus Section 51
Committee, on Duty-free Importations, report of 13, 75; on Standards of Measurement, 13, 17, 75, 77; on Coal Analysis, report of, 17, 75; on Enlarging the Committee on Papers and Publications, report of, 17, 23, 81; on Nomenclature and Spelling for the Journal, report of, 17, 75; on Water Analysis, asks to be Discharged, 13, 17; on Patents and Patent Legislation, 17, 22, 29, 75; on Atomic Weights, International, 19; to Attend Pure Food Congress, 23; on Finance, election of, 38; on Membership, election of, 38; on Standards of Instruments of Measure, report of, 69; on Bunsen Memorial, 76; on Frankland Memorial, 76; on Abstracts and Reviews, 80; on Appropriations for Library, 80; on Exchanges, 80; on Foreign Postage, 80; on Life Membership Fund, 80; on Papers and Publications, enlargement of, 81, 91; on Membership 100

Congress of Applied Chemistry, Fourth International 77
Constitution, amendments to..... 20
Council 1, 20, 29, 38, 49, 55, 69, 73, 79, 91; Increase in membership of, 12; list of members of new..... 23
Crampton, C. A., and F. D. Simons. The Detection of Coloring-matter in Spirits and Vinegar..... 40
"Culinary phosphates" 64

Cyanide solutions, rate of loss in..... 4

DAY, DAVID T. Characteristics of Iridosmium in the United States, 41; Uses of Fuller's Earth as a Filtering Medium..... 42
DeSchweinitz, E. A. The Serum Treatment of Some Animal Diseases..... 31
DeSchweinitz, E. A., J. A. Emory and F. K. Cameron. On the Estimation of Nicotine 32
Diamond, occurrence in Ohio..... .....8, 19, 43
Dinner at Meetings, recommendation of council..... 21
Directors, meetings, 20, 37, 87, 91; election of 38
Dye, C. A. Drug Using and Drug Proving..... 51

EDITOR, salary of, 1; authorized to increase size of December, 1898, issue, 1; authorized to retain 10 copies of Journal, 21; authorized to increase size of January, February, and March Nos. of Journal, 21; foreign postage, 21; letters to, concerning the publication of papers on physical chemistry, 21; election of.. 38
Election of Officers, New York Section, 7; Cincinnati Section, 8; Chicago Section, 8; of the Society for 1899, 38; of North Carolina Section, 45; of Columbus Section, 52; of New York Section, 68; Rhode Island Section..... 90
Elements recently announced..... 6
Exchanges, revision of list of..... 13
Experimentation in organic chemistry..... 6

FATS, bromine absorption of..... 34
Filtration, use of Fuller's earth in..... 42
Finances of the Society..... 13, 14, 38
Foulk, —. Solubility of Platinum in Fused Sodium Carbonate..... 52
Fourneaux, E. A. The Process of Mercerizing..... 47
Frankland, Edward, Committee to Prepare Memorial on..... 76
Fuller's earth as a filtering medium, uses of..... 42

GEISLER, J. F. Paraffin in Butter..... 45
Granja, Rafael. The Mordanting and Dyeing of Silk..... 98
Guncotton acid, examination of 5

HAYWOOD, J. K. The Determination of Calcium and Magnesium in Ashes, 61; Some Boiling-point Curves..... 61
Hallock, Albert P., elected treasurer, 55; resignation from Finance Committee 69
Honorary members, election of..... 14
"Husa," investigation of..... 53

INDEX, bids for printing, 37; price fixed for..... 37
Indicators..... 34
International Committee on Atomic Weights..... 19
Iridosmium in the United States, characteristics of..... 41

JOURNAL, increase in the edition of. 13
Job, Robert. Some Causes of Excessive Friction in Bearing metals..... 96

KAUFFMAN, G. B. Essential Oils..... 51

LEHIGH Valley Section..... .....27, 59
Librarian, annual report of, 16; election of, 38; authorized to reprint January, 1899, issue..... 55
Library, transfer to rooms of Chemists' Club 13, 16

Life Membership Fund, report of Committee on, 1, 13; correspondence concerning the 47
Lloyd, John Uri. An Investigation into "Husa" an Asserted Plant Preparation to Cure the Opium Habit 53
Local Sections 3, 27, 31, 40, 50, 59, 67, 73, 89, 96
Lord, N. W. Technical Analysis 51
Low temperatures, effect on chemical reactions 17

MAGNESIUM in ashes, determination of 61
McIlhiney, P. C. The Bromine Absorption of Fats 34
McKenna, C. F. Resolutions on Acceptance of Resignation as Treasurer 55
Means, T. H., and F. K. Cameron. Field Estimation of the Salt Contents of Soil Waters 60
Membership, gain in, 12; nominations to, 21; of the society 75
McMurtrie, Wm. Some Notes on the Year's Progress in Applied Chemistry 98
Mercerizing, the process of 47
Munroe, C. E. The Examination of Acid for Use in the Manufacture of Guncotton; Explosions Caused by Commonly Occurring Substances (Presidential Address) .. 18

NAMES Proposed for Membership and Associate Membership 1, 25, 29, 39, 49, 56, 67, 70, 73, 85, 88, 92, 93
Necrology roll during the year 1898, 14; necrology 75
New members and associates elected 3, 25, 39, 56, 70, 93, 94
New York meeting of the society, minutes of the, 9; excursions during the, 11; secretary's report read during the, 12; treasurer's report read during the, 14; librarian's report read during the, 16; reports of committees at the, 17; election of officers, 17; lecture of Prof. Raoul Pictet, 17; address of President Munroe, 18; visit to Columbia College, 18; visit to the City College, 19; lecture by Chas. E. Tripler, 19; dinner at the Waldorf-Astoria, 20; adjourned by council 21
New York Section 7, 33, 44, 54, 63, 67
Nicotine, estimation of 32
Norris, J. F. Tellurium and the Periodic Law 99
North Carolina Section 45, 103
North Eastern Section 35, 99
Norton, T. H. Occurrence of the Diamond in Various Parts of the United States and on the First Occurrence of the Diamond in Ohio 8
Notice 28

PARAFFIN from butter 45
Paris Exposition, correspondence relating to 54
Peppel, ——. Stability of Sodium Thiosulphate solutions 52
Philadelphia Section 49, 63, 73, 90, 96
Pictet, Raoul, lecture by 17
Platinum, solubility in fused sodium carbonate 52
Portrait of retiring president 22
Pure Food Congress, Committee to attend 22

RHODE ISLAND SECTION 6, 46, 65, 90, 99
Richards, J. W. A Portable Specific Gravity Apparatus, 28; A New Form of Button Scale for Use in Quantitative Blowpipe Analysis 28

SAFE of the Society, officers to have access to 37
Saunders, Walter M. Alloys 46
Secretary, annual report of, 12; authorized to buy typewriter, 21; election of 38
Serum treatment of some animal diseases 31
Shimer, Porter W. Silica and the Insoluble Residue in Portland Cement 27
Silica in Portland cement, determination of 27
Silicates, constitution of certain 89
Silk, mordanting and dyeing of 98
Simons, F. D. See Crampton, C. A 40
Smith, Edgar F. Resignation as a member of Committee on Papers and Publications refused 81

Soil waters, estimation of salt contents of..... 60
Specific gravity apparatus..... 28
Spirits, detection of caramel in..... 40
Starch, determination of..... 18
Steiger, George. See Clarke, F. W.

TELLURIUM and the periodic law..... 99
Ternary mixture, a..... 4
Thiosulphate solutions, stability of..... 52
Treasurer, annual report of, 14; payment of office expenses of, 38; accounts audited, 38; election of, 38; to give bonds, 82; report of..... 83

VINEGAR, detection of caramel in..... 40
Vinson, ——. Mechanical Separation of Butter-fat from Milk..... 53
Volumetric apparatus, report of committee on graduating..... 69

WADDELL, JOHN Indicators..... 34
Wainwright, J. H. elected member of Finance Committee..... 69
Washington Section.....3, 31, 40, 60, 89
Weber, H. A. The Summer Meeting of the American Association for the Advancement of Science..... 51
Wiley, H. W. Determination of Starch (in Discussion)..... 18